

WL-TR-94-4053  
Volume 2, Chapters 5 and 6



## **DAMAGE TOLERANT DESIGN HANDBOOK**

**D.A. Skinn, J.P. Gallagher, A.P. Berens,  
P.D. Huber, J. Smith**

**University of Dayton Research Institute  
300 College Park Dr  
Dayton, OH 45469-0120**

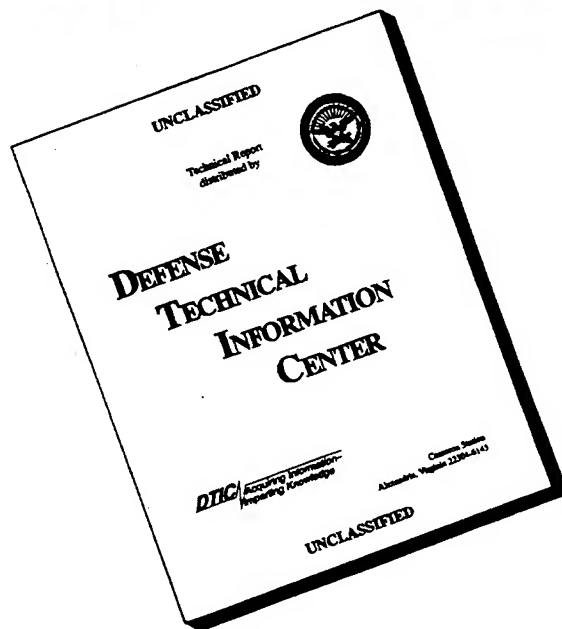
**May 1994  
Final Report for Period June 1991 - May 1994**

**Approved for public release; distribution unlimited**

**Materials Directorate  
Wright Laboratory  
Air Force Materiel Command  
Wright Patterson AFB, Ohio 45433-7734**

**19960809 031**

# DISCLAIMER NOTICE



**THIS DOCUMENT IS BEST  
QUALITY AVAILABLE. THE  
COPY FURNISHED TO DTIC  
CONTAINED A SIGNIFICANT  
NUMBER OF PAGES WHICH DO  
NOT REPRODUCE LEGIBLY.**



REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE MAY 1994	3. REPORT TYPE AND DATES COVERED FINAL 06/19/91--05/19/94		
4. TITLE AND SUBTITLE DAMAGE TOLERANT DESIGN HANDBOOK  VOL 2, CHAPTERS 5 AND 6		5. FUNDING NUMBERS C F33615-91-C-5610 PE 62102 PR 2418 TA 04 WU 91		
6. AUTHOR(S) D.A. SKINN, J.P. GALLAGHER, A.P. BERENS, P.D. HUBER, J. SMITH				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) UNIVERSITY OF DAYTON RESEARCH INSTITUTE 300 COLLEGE PARK DAYTON OH 45469-0120		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) MATERIALS DIRECTORATE WRIGHT LABORATORY AIR FORCE MATERIEL COMMAND WRIGHT PATTERSON AFB OH 45433-7734		10. SPONSORING/MONITORING AGENCY REPORT NUMBER WL-TR-94-4053		
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT  APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words)  This report presents a compilation of mechanical property data that are useful for damage tolerant design and analyses. The data of this handbook combines the old data that were previously presented in MCIC-HB-OIR (Damage Tolerant Design Handbook, December 1983) and more recent data that were collected from various sources. The fracture toughness, crack growth, R-curve, sustained load and threshold data are for alloy and stainless steels, nickel based super alloys, titanium alloys and aluminum alloys.				
14. SUBJECT TERMS MECHANICAL PROPERTIES FRACTURE TOUGHNESS SUBCRITICAL CRACK GROWTH		R-CURVES SUSTAINED LOAD THRESHOLD		15. NUMBER OF PAGES 787
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED		18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	16. PRICE CODE UL
20. LIMITATION OF ABSTRACT UL				

## GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to *stay within the lines* to meet *optical scanning requirements*.

**Block 1:** Agency Use Only (Leave blank).

**Block 2.** Report Date. Full publication date including day, month, and year, if available (e.g. 1 Jan 88). Must cite at least the year.

**Block 3.** Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

**Block 4.** Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

**Block 5.** Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

C - Contract	PR - Project
G - Grant	TA - Task
PE - Program Element	WU - Work Unit Accession No.

**Block 6.** Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

**Block 7.** Performing Organization Name(s) and Address(es). Self-explanatory.

**Block 8.** Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

**Block 9.** Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

**Block 10.** Sponsoring/Monitoring Agency Report Number. (If known)

**Block 11.** Supplementary Notes. Enter information not included elsewhere such as: Prepared in cooperation with...; Trans. of...; To be published in.... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

**Block 12a.** Distribution/Availability Statement. Denotes public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

DOD - See DoDD 5230.24, "Distribution Statements on Technical Documents."

DOE - See authorities.

NASA - See Handbook NHB 2200.2.

NTIS - Leave blank.

**Block 12b.** Distribution Code.

DOD - Leave blank.

DOE - Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.

NASA - Leave blank.

NTIS - Leave blank.

**Block 13.** Abstract. Include a brief (*Maximum 200 words*) factual summary of the most significant information contained in the report.

**Block 14.** Subject Terms. Keywords or phrases identifying major subjects in the report.

**Block 15.** Number of Pages. Enter the total number of pages.

**Block 16.** Price Code. Enter appropriate price code (*NTIS only*).

**Blocks 17. - 19.** Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contains classified information, stamp classification on the top and bottom of the page.

**Block 20.** Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.

# *Table of Contents*

---

## **VOLUME 1**

<u>Chapter</u>		<u>Page</u>
1	Handbook Organization and Content .....	1-1
1.0	Overview .....	1-1
1.1	Organization .....	1-2
1.2	Data Ordering and Abbreviations .....	1-5
1.2.1	Sorting Order .....	1-5
1.2.2	Abbreviations .....	1-5
1.3	Material Chapter Summaries .....	1-5
1.3.1	Available Data Summary .....	1-12
1.3.2	Plane Strain Fracture Toughness Material Data Summary .....	1-12
1.3.3	Plane Stress and Transitional Fracture Material Data Summary .....	1-15
1.3.4	Fatigue Crack Growth Rate Material Data Summary .....	1-15
1.3.5	Stress Corrosion Cracking Threshold Material Data Summary .....	1-19
1.4	Alloy Section Summaries .....	1-21
1.5	Alloy Fracture Toughness Subsection Formats .....	1-23
1.5.1	Plane Strain Fracture Toughness Data .....	1-25
1.5.2	Plane Stress Fracture Toughness Data .....	1-25
1.5.3	R-Curve Data .....	1-29
1.6	Subcritical Crack Growth Subsection Formats .....	1-29
1.6.1	Fatigue Crack Growth Rate Data .....	1-31
1.6.2	Sustained Load Crack Growth Rate .....	1-36
1.6.3	Stress Corrosion Cracking Threshold .....	1-38
2	Methods of Calculation .....	2-1
2.0	Overview .....	2-1
2.0.1	Data Review and Acceptance Criteria .....	2-1
2.0.2	Fracture Mechanics Basis .....	2-3
2.0.3	Test Specimen Geometries .....	2-4

2.1	Plane-Strain Fracture Toughness ( $K_{Ic}$ )	2-12
2.2	Critical Plane Stress Fracture Toughness	2-20
2.2.1	Plane Stress and Transitional Fracture Toughness	2-20
2.2.2	Plane Stress and Transitional Fracture Toughness Testing	2-23
2.2.3	Critical Stress-Intensity Factor ( $K_{Ic}$ )	2-23
2.3	The Apparent Fracture Toughness	2-26
2.4	R-Curve ( $K_R$ Versus $\Delta a_{eff}$ )	2-26
2.5	Fatigue Crack Growth Rate	2-30
2.5.1	Fatigue Crack Growth Behavior	2-30
2.5.2	Data Acceptance Criteria	2-32
2.5.3	Data Reduction Procedures	2-33
2.5.4	Data Reporting Procedures	2-35
2.6	Sustained-Load Crack Growth Rates	2-38
2.6.1	Sustained-Load Crack Growth Behavior	2-38
2.6.2	Data Acceptance Criteria	2-40
2.6.3	Data Reduction Procedures	2-40
2.6.4	Data Reporting Procedures	2-40
2.7	Threshold Stress Intensity ( $K_{Isc}$ )	2-41
2.7.1	The Threshold	2-41
2.7.2	Conditions for Validity of Data	2-43
3	Alloy Steel Sections	3-1
3.0	Alloy Steel Material Summaries	3-3
3.0.1	Available Data Summary	3-3
3.0.2	$K_{Ic}$ Summary	3-20
3.0.3	$K_{Ic}$ Summary (Without Buckling Constraints)	3-27
3.0.4	FCGR at Defined $\Delta K$ Levels	3-28
3.0.5	$K_{Isc}$ Summary	3-33
3.1	10Ni Steel	3-39
3.2	12-9-2(MAR)	3-48
3.3	12Ni-5Cr-3Mo	3-51
3.4	18Ni(180)(MAR)	3-52
3.5	18Ni(200)(MAR)	3-53
3.6	18Ni(250)	3-56
3.7	18Ni(250)(MAR)	3-59
3.8	18Ni(280)(MAR)	3-67
3.9	18Ni(300)	3-68
3.10	18Ni(300)(MAR)	3-70

3.11	18Ni(350)	3-88
3.12	18Ni(350)(MAR)	3-89
3.13	300M	3-90
3.14	300M(AM)	3-134
3.15	300M(VAR)	3-136
3.16	300M(VM)	3-138
3.17	4140	3-140
3.18	4330V	3-143
3.19	4330V(MOD)	3-144
3.20	4340	3-149
3.21	4340(AM)	3-194
3.22	4340(DH)	3-196
3.23	4340(EFM)	3-198
3.24	4340(MOD)	3-199
3.25	4340(VAR)	3-200
3.26	4340V	3-202
3.27	A286	3-204
3.28	AF1410	3-212
3.29	AF1410(VIM-VAR)	3-222
3.30	D6AC	3-233
3.31	H11	3-300
3.32	HP9-4-.20	3-308
3.33	HP9-4-.20(CEVM)	3-348
3.34	HP9-4-.25(VAR)	3-354
3.35	HP9-4-.30	3-356
3.36	HP9-4-.45	3-423
3.37	HY-150	3-424
3.38	HY-180	3-425
3.39	HY-80	3-428
3.40	HY-TUF	3-431
3.41	Alloy Steel References	3-433

4	Stainless Steel Sections	4-1
4.0	Stainless Steel Material Summaries	4-3
4.0.1	Available Data Summary	4-3
4.0.2	$K_{Ic}$ Summary	4-9
4.0.4	FCGR at Defined $\Delta K$ Levels	4-11
4.0.5	$K_{Isc}$ Summary	4-15
4.1	15-5PH	4-17
4.2	15-5PH(AM)	4-47
4.3	15-5PH(VM)	4-48
4.4	17-4PH	4-49
4.5	17-7PH	4-61
4.6	21-6-9 NI40	4-69
4.7	304	4-72
4.8	316	4-86

4.9	347	4-92
4.10	AFC 260	4-97
4.11	AFC 77	4-98
4.12	AFC 77(VAR)	4-103
4.13	AM 355	4-106
4.14	AM 362	4-107
4.15	AM 364	4-108
4.16	CUSTOM 455	4-109
4.17	PH13-8Mo	4-119
4.18	PH14-8Mo	4-193
4.19	PH15-7Mo	4-194
4.20	Stainless Steel References	4-197

## VOLUME 2

5	Nickel Based Super Alloys Sections	5-1
5.0	Nickel Based Super Alloys Material Summaries	5-3
5.0.1	Available Data Summary	5-3
5.0.2	$K_{Ic}$ Summary	5-6
5.0.3	$K_{Ic}$ Summary (Buckling not Constrained)	5-7
5.0.4	FCGR at Defined $\Delta K$ Levels	5-8
5.0.5	$K_{Isc}$ Summary	5-12
5.1	ASTROLOY 901	5-13
5.2	ASTROLOY P/M-H	5-24
5.3	ASTROLOY P/M-W	5-26
5.4	IN100	5-28
5.5	IN100 P/M-G	5-52
5.6	INCOLOY 901	5-54
5.7	INCONEL 600	5-56
5.8	INCONEL 625	5-63
5.9	INCONEL 718	5-68
5.10	NASA IIB-7 P/M	5-162
5.11	P/M RENE 95	5-163
5.12	RENE 95 (H&F)	5-170
5.13	WASPALLOY	5-171
5.14	Nickel Based Super Alloys Reference	5-198
6	Titanium Alloys Sections	6-1
6.0	Titanium Alloys Material Summaries	6-3
6.0.1	Available Data	6-3
6.0.2	$K_{Ic}$ Summary	6-15
6.0.3.1	$K_{Ic}$ Summary (Buckling not Constrained)	6-18
6.0.3.2	$K_{Ic}$ Summary (Buckling Constrained)	6-19
6.0.4	FCGR at Defined $\Delta K$ Levels	6-20
6.0.5	$K_{Isc}$ Summary	6-35

6.1	BETA	6-38
6.2	BETA C	6-39
6.3	BETA III	6-47
6.4	BETA Ti	6-59
6.5	CORONA 5	6-61
6.6	IMI-834	6-62
6.7	Ti-*	6-68
6.8	Ti-10-2-3	6-69
6.9	Ti-4Al-3Mo-1V	6-72
6.10	Ti-5-2.5 ELI	6-73
6.11	Ti-5Al-2.5Sn	6-102
6.12	Ti-6-2-2-2-2	6-126
6.13	Ti-6-2-4-2	6-134
6.14	Ti-6-2-4-2 ELI	6-141
6.15	Ti-6-2-4-6	6-154
6.16	Ti-6Al-4V	6-169
6.17	Ti-6Al-4V ELI	6-433
6.18	Ti-6Al-6V-2Sn	6-473
6.19	Ti-6Al-6V-2.5Sn	6-515
6.20	Ti-6Al2Sn4Zr6Mo	6-516
6.21	Ti-8Al-1Mo-1V	6-518
6.22	Ti-Mo8V2Fe3Al	6-567
6.23	Ti-5Al2.5Sn ELI	6-569
6.24	Ti-6Al6V2Sn ELI	6-571
6.25	Titanium Alloys References	6-573

### VOLUME 3

7	Aluminum 2000/6000 Series Alloys Sections	7-1
7.0	Aluminum 2000/6000 Series Material Summaries	7-3
7.0.1	Available Data	7-3
7.0.2	$K_{Ic}$ Summary	7-8
7.0.3.1	$K_{Ic}$ Summary (Buckling not Constrained)	7-10
7.0.3.2	$K_{Ic}$ Summary (Buckling Constrained)	7-12
7.0.4	FCGR at Defined $\Delta K$ Levels	7-13
7.0.5	$K_{Isc}$ Summary	7-25
7.1	2014	7-27
7.2	2020	7-65
7.3	2020 (ALCLAD)	7-78
7.4	2021	7-79
7.5	2024	7-82
7.6	2024 (ALCLAD)	7-378
7.7	2048	7-397
7.8	2091	7-416
7.9	2124	7-451

7.10	2214	7-556
7.11	2219	7-561
7.12	2324	7-654
7.13	2419	7-657
7.14	2618	7-668
7.15	6061	7-674
7.16	A201	7-682
7.17	A357	7-686
7.18	AL905XL	7-691
7.19	IN905XL	7-704
7.20	Aluminum 2000/6000 Series References	7-719

## VOLUME 4

8	Aluminum 7000/8000 Series Alloys Sections	8-1
8.0	Aluminum 7000/8000 Series Material Summaries	8-3
8.0.1	Available Data	8-3
8.0.2	$K_{Ic}$ Summary	8-12
8.0.3.1	$K_c$ Summary (Buckling not Constrained)	8-16
8.0.3.2	$K_c$ Summary (Buckling Constrained)	8-19
8.0.4	FCGR at Defined $\Delta K$ Levels	8-20
8.0.5	$K_{Isc}$ Summary	8-41
8.1	7001	8-45
8.2	7005	8-53
8.3	7007	8-62
8.4	7010	8-63
8.5	7039	8-80
8.6	7049	8-81
8.7	7050	8-136
8.8	7050 (ALCLAD)	8-435
8.9	7075	8-452
8.10	7075 (ALCLAD)	8-745

## VOLUME 5

8.11	7079	8-766
8.12	7079 (ALCLAD)	8-833
8.13	7080	8-836
8.14	7149	8-837
8.15	7150	8-849
8.16	7175	8-877
8.17	7178	8-969
8.18	7178 (ALCLAD)	8-1019
8.19	7475	8-1020
8.20	7475 (ALCLAD)	8-1292



8.21	8009	8-1323
8.22	8090	8-1328
8.23	X7090	8-1344
8.24	X7091	8-1348
8.25	Aluminum 7000/8000 Series References	8-1354



## ***Foreword***

---

This report summarizes the results of a damage tolerant, material property data collection and reporting program conducted under USAF Contract F33615-91-C-5610. The work was sponsored by the Materials Directorate of Wright Laboratory with Mr. Jack Coate of the Systems Support Division serving as the project monitor. The technical effort was conducted between June 1991 and January 1994. The work was performed by the University of Dayton Research Institute under the general supervision of Dr. Joseph P. Gallagher with Dr. Alan P. Berens serving as Principal Investigator.

This final report comprises eight chapters which are presented in five volumes as follows:

<u>VOLUME</u>	<u>CHAPTER</u>	<u>DESCRIPTION</u>
1	1	Handbook organization and content
	2	Methods of calculation
	3	Alloy Steels
	4	Stainless Steels
2	5	Nickel Based Super Alloys
	6	Titanium Alloys
3	7	Aluminum 2000/6000 Series Alloys
4 & 5	8	Aluminum 7000/8000 Series Alloys

A detailed listing of the materials represented in the Handbook is contained in the preceding Table of Contents. In the body of the Handbook, the pages are numbered within chapters and the relevant portion of the table of contents is repeated at the beginning of each chapter.

## CHAPTER 5

### NICKEL BASED SUPER ALLOYS SECTIONS

5.0	Nickel Based Super Alloys Material Summaries .....	5-3
5.0.1	Available Data Summary .....	5-3
5.0.2	$K_{Ic}$ Summary .....	5-6
5.0.3.1	$K_c$ Summary (Buckling not Constrained) .....	5-7
5.0.4	FCGR at Defined $\Delta K$ Levels .....	5-8
5.0.5	$K_{Isc}$ Summary .....	5-12
5.1	ASTROLOY 901 .....	5-13
5.2	ASTROLOY P/M-H .....	5-24
5.3	ASTROLOY P/M-W .....	5-26
5.4	IN100 .....	5-28
5.5	IN100 P/M-G .....	5-52
5.6	INCOLOY 901 .....	5-54
5.7	INCONEL 600 .....	5-56
5.8	INCONEL 625 .....	5-63
5.9	INCONEL 718 .....	5-68
5.10	NASA IIB-7 P/M .....	5-162
5.11	P/M RENE 95 .....	5-163
5.12	RENE 95 (H&F) .....	5-170
5.13	WASPALLOY .....	5-171
5.14	Nickel Based Super Alloys References .....	5-198

TABLE 5.0.1

1 of 3

## AVAILABLE DATA FOR NICKEL ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>Ic</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Isc</sub>
ASTROLOY 901	Unspecified	Unspecified				15		
ASTROLOY P/M-H	2025F 3HR AC 1600F 8HR AC	Disk				8		
ASTROLOY P/M-W	2025F 4HRS AC 1600F 8HRS AC	Disk				8		
IN100	Unspecified	Unspecified				16		
		Forging				32		
		Forging				1		
IN100 P/M-G	2050F 2HRS OQ 1600F 0.67HR AC	Disk				6		
INCOLOY 901	Unspecified	Unspecified				1		
INCONEL 600	1585F .75HR AC	Plate				19		
INCONEL 625	MA	Plate				11		
INCONEL 718	Unspecified	Unspecified				4		
	1325F 8 HR FC TO 1150F HOLD 18 HR	Forging	1					
	1325F 8HRS FC TO 1150F	Forging				3		
	1325F 9 HR FC TO 1150F AT 100F/HR HOLD AT 1150F 8 IIR AC	Forging	2					
	1750F 1HR AC 1325F	Plate				2		
	1750F AC	Forged Bar				5		
		Sheet				1		
INCONEL 718	1750F AC 1325F	Sheet				3		
		Plate				23		
		Forging				5		
		Forged Bar				5		
						5		

TABLE 5.0.1 (CONTINUED)

## AVAILABLE DATA FOR NICKEL ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>IC</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Isc</sub>
INCONEL 718 (Cont)	1750F 1HR Q 1 325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR	Disk				15		
	1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR	Disk				30		
	1760F 1HR WQ 1325F 8HRS	Disk				5		
	1800F 1HR Q 1325F 8HRS FC TO 1150F HOLD 8HRS AC	Forging				4		
	1850F 1.5HR OQ 1360F 9HRS FC TO 1175F	Forged Bar						8
	1880F 1HR AC 1520F 8HR FC 1200F 16HR AC	Sheet						5
	1950F AC 1325F	Plate				4		
	ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HOUR TO 1150F, 1150F 8HR, AC	Plate				13		
	COLD ROLLED 30PERCENT AND AGED	Sheet		59				
	ST 1850F 1360 F 9HRS F/C 1175F	Forged Bar				11		
	ST-CW-A	Round Bar	3					
	STA	Forging	7			20		
		Round Bar	4					
NASA IIB-7 P/M	1650F 16HRS TO 2000F 1HR OQ	Disk				7		
P/M RENE 95	2080F 1HR AC 1600F 1HR AC	Disk				8		
	2100F 1HR SQ AT 1000F	Disk				4		
RENE 95 (H&F)	2000F 1HR SQ AT 1000F	Forging				4		
WASPALLOY	Unspecified	Unspecified				2		
		Forging				36		

TABLE 5.0.1 (CONCLUDED)

## AVAILABLE DATA FOR NICKEL ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>ic</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Isc</sub>
WASPALLOY (Con't)	1860F 2HRS 1350F 6HRS	Billet				1		
	1850F 2HRS 1600F 24HRS (FINE GS)	Billet				1		
	1875F 4HRS OQ 1550F 41HRS AC	Disk				9		
	2010F 2HRS 1350F 6HRS	Billet				1		
	2010F 2HRS 1600F 24HRS	Billet				1		

TABLE 5.0.2

1 of 1

**PLANE STRAIN FRACTURE TOUGHNESS VALUES OF NICKEL BASE SUPER ALLOYS  
AT ROOM TEMPERATURE**

Alloy	Condition/ Heat Treatment	Product Form	Range of Product Thickness (in.)	$K_{Ic} \text{ (Ksi}\sqrt{\text{in}}\text{)}$											
				Specimen Orientation											
				L-T				T-L				S-L			
				Min Spec Thk	n	Mean	Std Dev	Min Spec Thk	n	Mean	Std Dev	Min Spec Thk	n	Mean	Std Dev
INCONEL 718	STA	Forging	3.00-3.30	1.50	2	118.5	0.7	1.50	2	107.9	14.0	...	...	...	...



TABLE 5.0.3.1

1 of 1

**PLANE STRESS AND TRANSITIONAL FRACTURE TOUGHNESS  
OF NICKEL BASE SUPER ALLOYS (WITHOUT BUCKLING CONSTRAINTS)**

Alloy	Condition/ Heat Treatment	Test Temp (°F)	Specimen		Yield Strength (Ksi)	$K_c$ ( $Ksi\sqrt{in}$ )											
						Specimen Thickness (in.)											
			Orient	Width (in.)		n - Sample size			$\mu$ - Mean			$\sigma$ - Standard Deviation					
						n	$\mu$	$\sigma$	n	$\mu$	$\sigma$	n	$\mu$	$\sigma$			
INCONEL 718	COLD ROLLED 30% AND AGED	-423.	L-T	4.0	269.0	15	191.1	7.5									
		-320.	L-T	4.0	259.0	13	200.5	13.8									
		R.T.	L-T	4.0	218.0	6	178.5	3.5									
				18.0	218.0	5	224.6	11.0									

TABLE 5.0.4.1

1 of 1

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR NICKEL BASED ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: Unspecified      STRESS RATIO: 0.05 - 0.1      FREQUENCY: 0.17 - 10. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (Ksi/in)					
					2.5	5.0	10.0	20.0	50.0	100.0
ASTROLOY 901	99	UNSPECIFIED	0.1	0.17				1.11	18.31	
INCONEL 625	MA	PLATE	0.05	10				2.07		
INCONEL 718	1750F 1HR AC 1325F	PLATE	0.05	10				1.65		
	1750F AC 1325F	SHEET	0.05	5				1.95		
		FORGING	0.05	10				1.93	40.69	
WASPALLOY	1850F 2HRS 1350F 6HRS	BILLET	0.1	10					10.46	
	2010F 2HRS 1350F 6HRS	BILLET	0.1	10					2.8	
	2010F 2HRS 1600F 24HRS	BILLET	0.1	10					9.56	

TABLE 5.0.4.2

1 of 1

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR NICKEL BASED ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: L-T      STRESS RATIO: -0.2 - 0.8      FREQUENCY: 4. - 30. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (Ksi/in)					
					2.5	5.0	10.0	20.0	50.0	100.0
INCONEL 718	1750F AC 1325F	PLATE	0.05	8.33				1.28	30.57	
	1950F AC 1325F	PLATE	0.05	8.33				1.05		
	ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HOUR TO 1150F, 1150F 8HR, AC	PLATE	-0.2	10				1.14		
			0.02	4				0.92	16.4	
			0.02	20				1.75		
			0.5	10				2.97		
	STA	FORGING	0.1	15-20				2.45	57.53	
			0.4	20				3.42		
			0.8	20-30			0.47			
	UNSPECIFIED	UNSPECIFIED	0.1	10			0.13	2.46	56.78	

TABLE 5.0.4.3

1 of 1

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR NICKEL BASED ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: T-L      STRESS RATIO: -1. - 0.8      FREQUENCY: 5. - 30. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (Kak/in)					
					2.5	5.0	10.0	20.0	30.0	100.0
INCONEL 718	1750F 1HR AC 1325F	FORGED BAR	0.05	8.33-10				3.08	116.49	
			-1	5				0.69	29.84	
			0.1	15-20				2.19	83.07	
			0.4	20				3.16		
	STA	FORGING	0.8	20-30			0.47			

TABLE 5.0.4.4

1 of 1

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR NICKEL BASED ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: C-R      STRESS RATIO: 0.0 - 0.05      FREQUENCY: 0.33 - 10. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-4}$ in/cycle)				
					$\Delta K$ Level ( $K_{\text{SI}}/\text{in}$ )				
					2.5	5.0	10.0	20.0	50.0
INCONEL 718	1750F AC 1325F	FORGED BAR	0.05	10				2.56	43.72
	1760F 1HR WQ 1325F 8HRS	DISK	0.	0.33				3.39	
P/M RENE 95	2080F 1HR AC 1600F 1HR AC	DISK	0.	0.33				0.4	31.02

TABLE 5.0.5

1 of 1

STRESS CORROSION CRACKING THRESHOLD DATA FOR NICKEL BASE ALLOYS AT ROOM TEMPERATURE								
Alloy	Condition/ Heat Treatment	Product Form	Specimen Orientation	$K_{I_{occ}} K_{SI} \sqrt{in}$				
				Environment				
				Shop Cleaning Solvent	Sump Tank Water	Martin- Marietta Refined Grade Hydrazine	Matheson- Coleman-Bell 97% Grade Hydrazine	Propellant Grade Hydrazine
INCONEL 718	1850F 1.5HR OQ 1360F 9HRS FC TO 1175F	Forged Bar	L-T	126(2)	133(2)			
			T-L		105(2)			
			S-L		93(2)			
	1880F 1HR AC 1520F 8HR FC 1200F 16HR AC	Sheet	---			79(2)	25.8	87.5

TABLE 5.1.1.2

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**ASTROLOY 901 AT ROOM TEMPERATURE**

ORIENTATION: Unspecified

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)				
				$\Delta K$ Level (Ksi/in)				
				2.5	5.0	10.0	20.0	50.0
UNSPECIFIED	UNSPECIFIED	0.1	0.17				1.11	18.31
								100.0

# ASTROLOY 901

Condition/Ht:

Form:

Specimen Type: SENT

Orientation:

Stress Ratio: 0.1

Yield Strength:

Ult. Strength:

Specimen Thk: 0.121 — 0.126 in.

Specimen Width: 2.5 in.

Ref: PW003

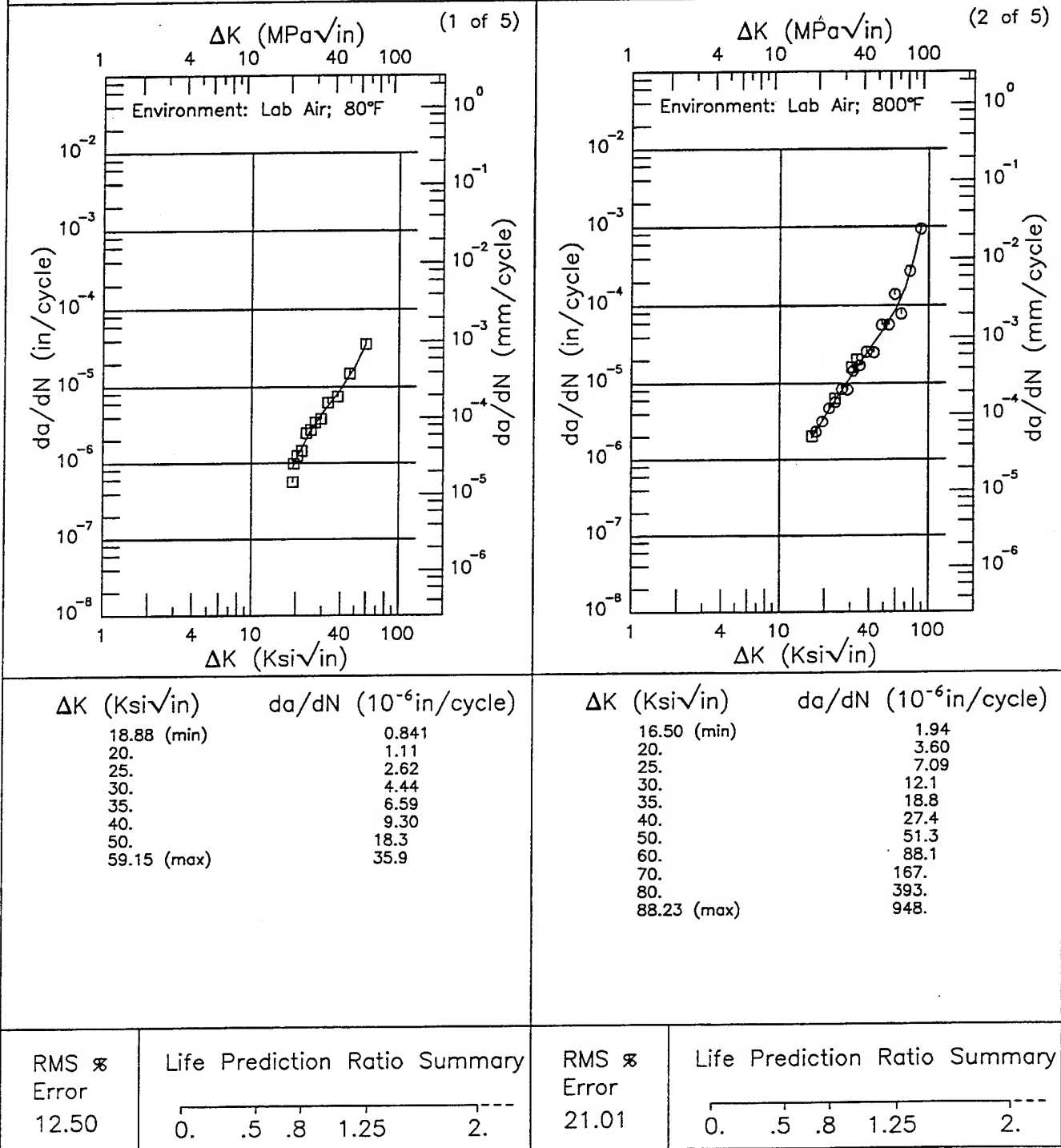


Figure 5.1.3.1.1



Condition/Ht:

Form:

Specimen Type: SENT

Orientation:

Stress Ratio: 0.1

Yield Strength:

Ult. Strength:

Specimen Thk: 0.121 - 0.126 in.

Specimen Width: 2.5 in.

Ref: PW003

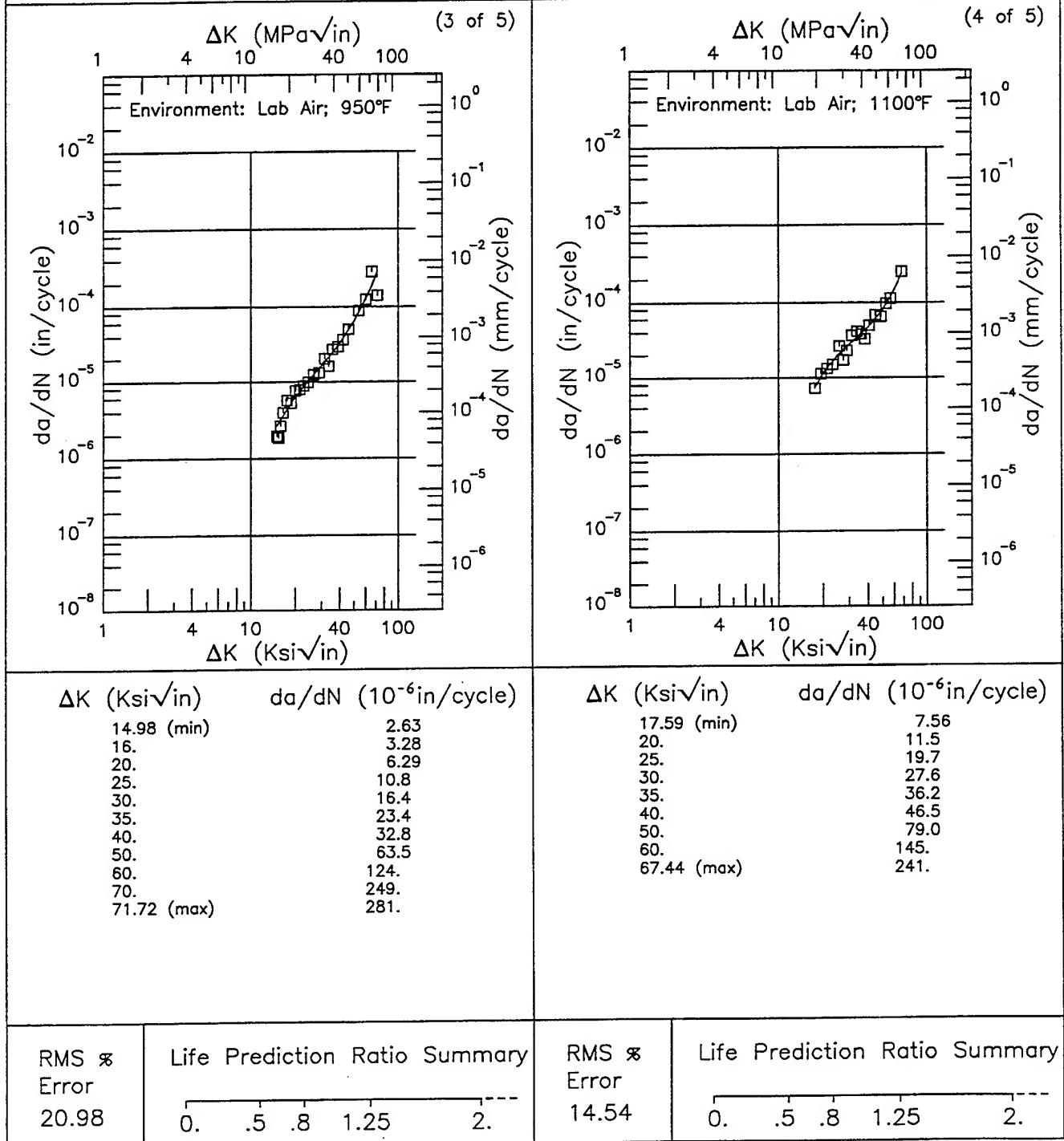


Figure 5.1.3.1.1 (Continued)

EF | ASTROLOY 901 |

Condition/Ht:

Form:

Specimen Type: SENT

Orientation:

Stress Ratio: 0.1

Yield Strength:

Ult. Strength:

Specimen Thk: 0.121 - 0.126 in.

Specimen Width: 2.5 in.

Ref: PW003

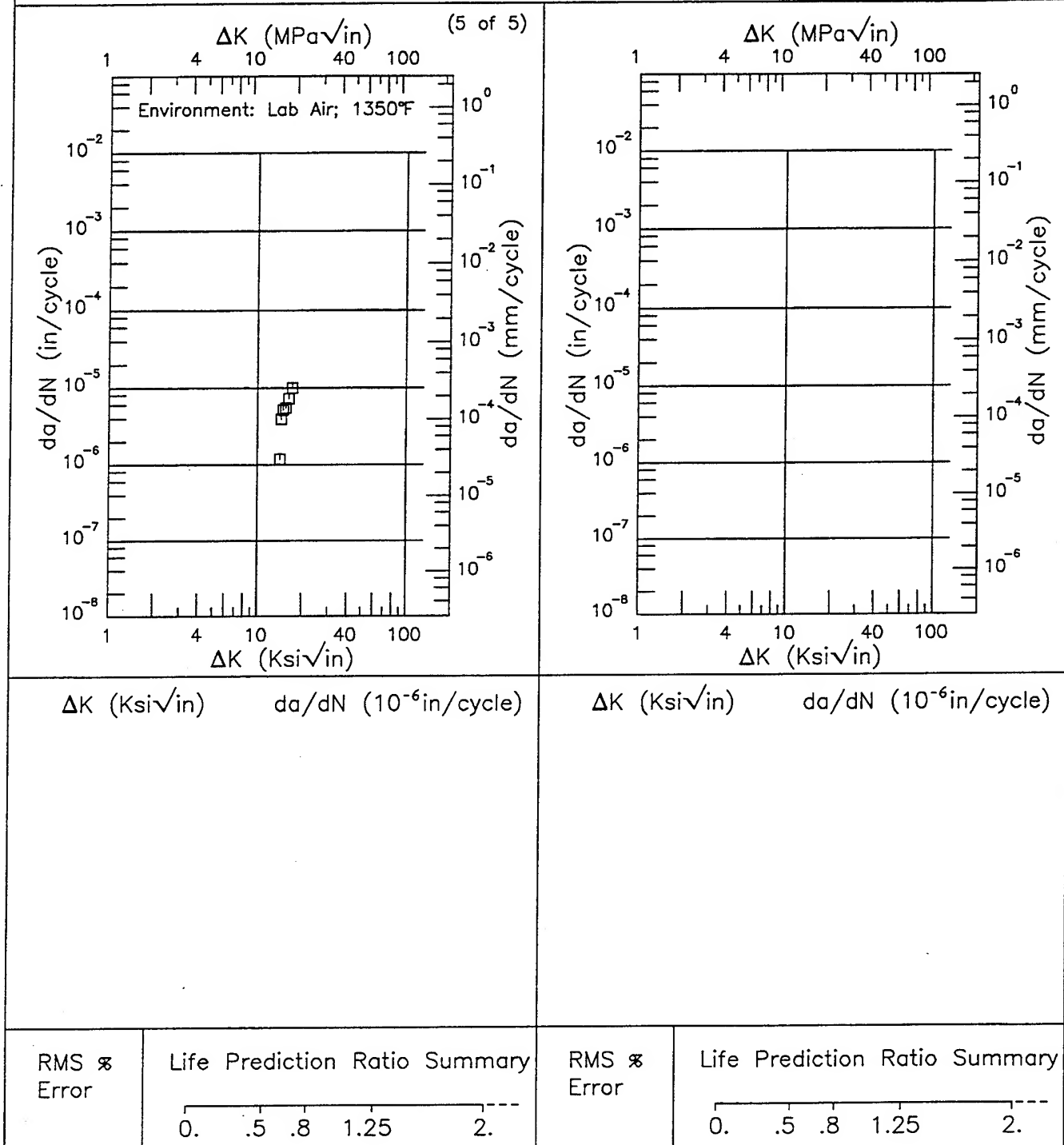


Figure 5.1.3.1.1 (Concluded)

**This page intentionally left blank**

# ASTROLOY 901

Condition/Ht:

Form:

Specimen Type: SENT

Orientation:

Stress Ratio: 0.5

Yield Strength:

Ult. Strength:

Specimen Thk: 0.12 - 0.124 in.

Specimen Width: 2.5 in.

Ref: PW003

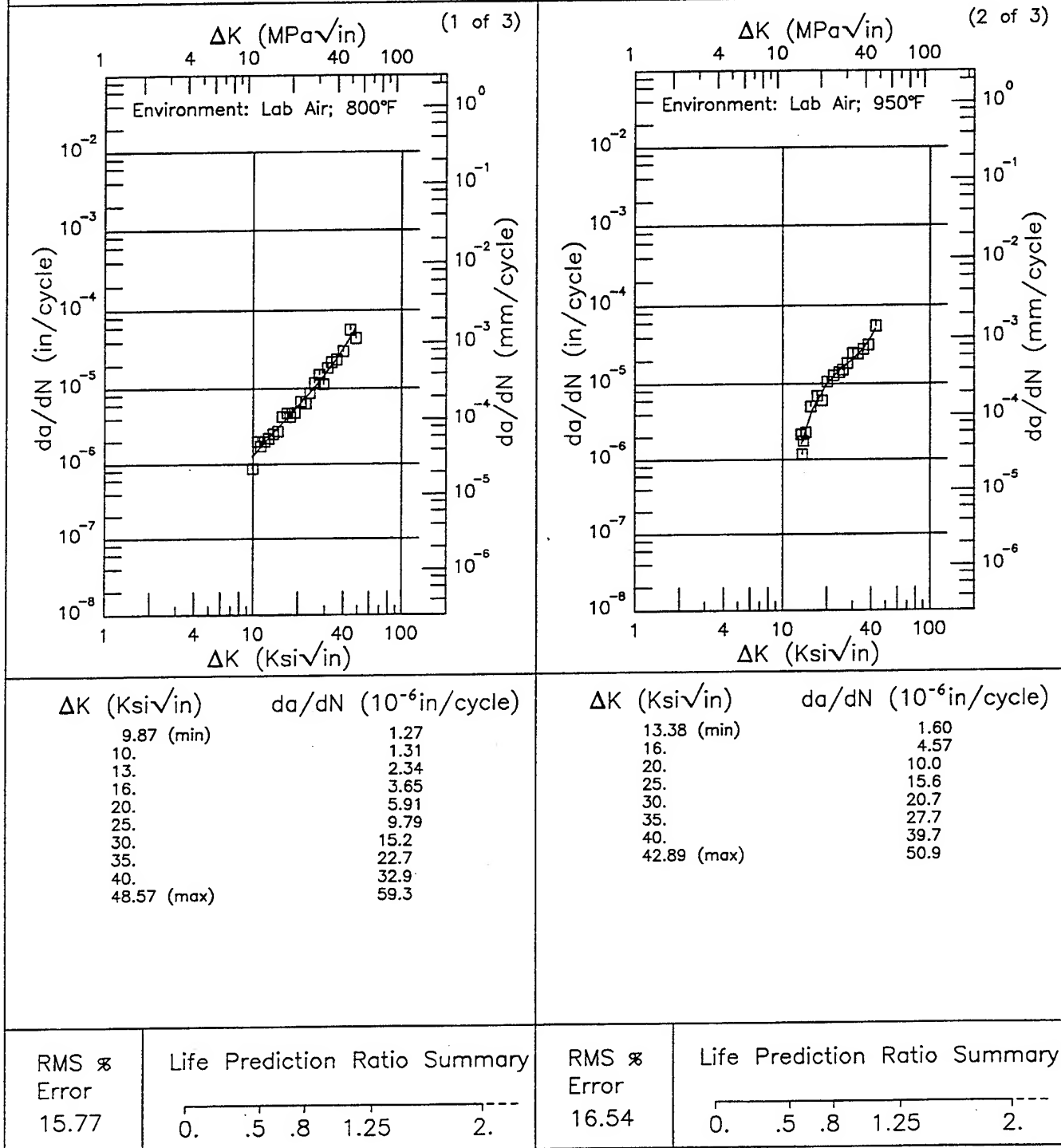


Figure 5.1.3.1.2

Condition/Ht:

Form:

Specimen Type: SENT

Orientation:

Stress Ratio: 0.5

Yield Strength:

Ult. Strength:

Specimen Thk: 0.12 - 0.124 in.

Specimen Width: 2.5 in.

Ref: PW003

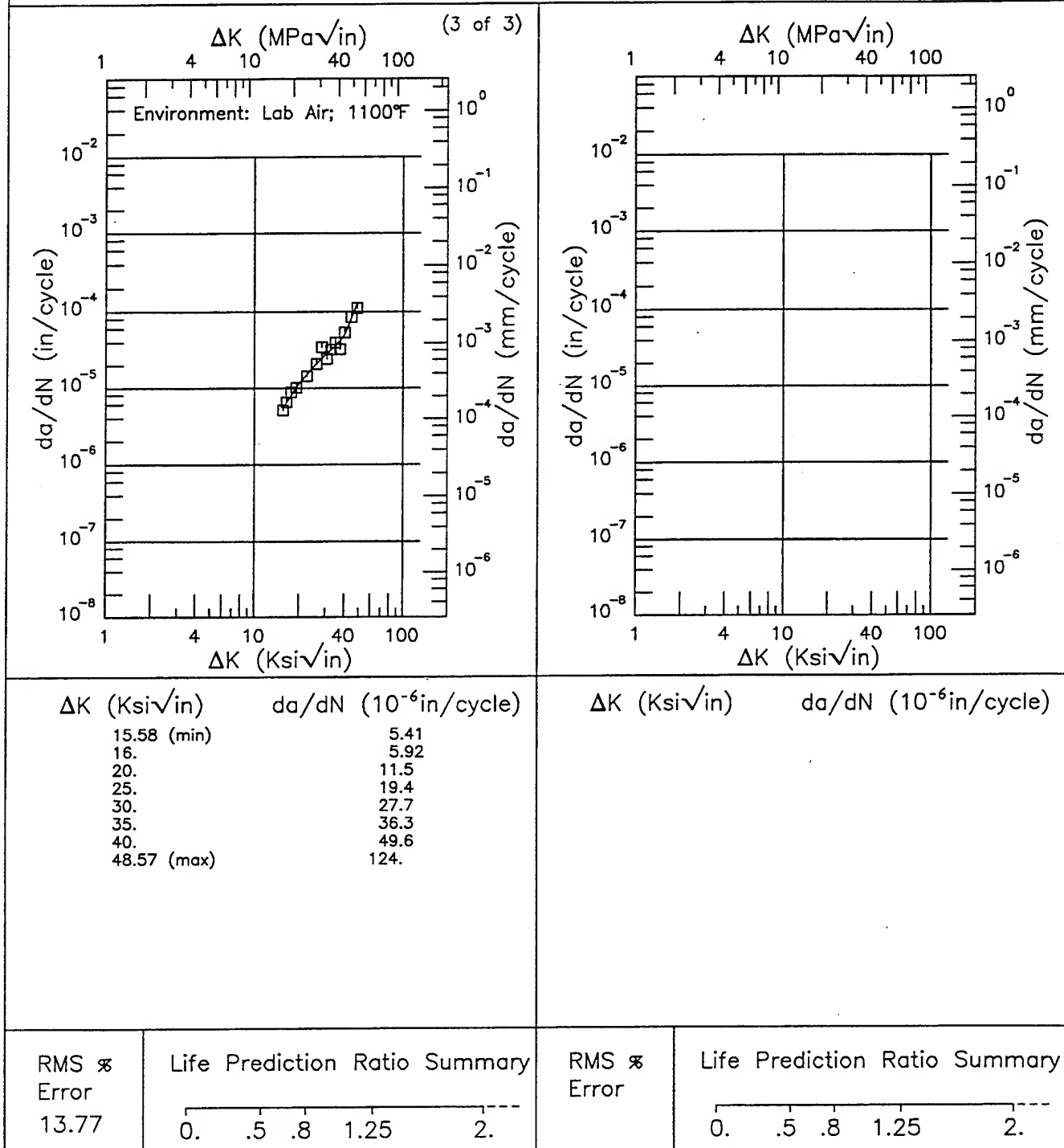


Figure 5.1.3.1.2 (Concluded)

# ASTROLOY 901

Condition/Ht:

Form:

Specimen Type: SENT

Orientation:

Stress Ratio: 0.7

Yield Strength:

Ult. Strength:

Specimen Thk: 0.119 - 0.123 in.

Specimen Width: 2.5 in.

Ref: PW003

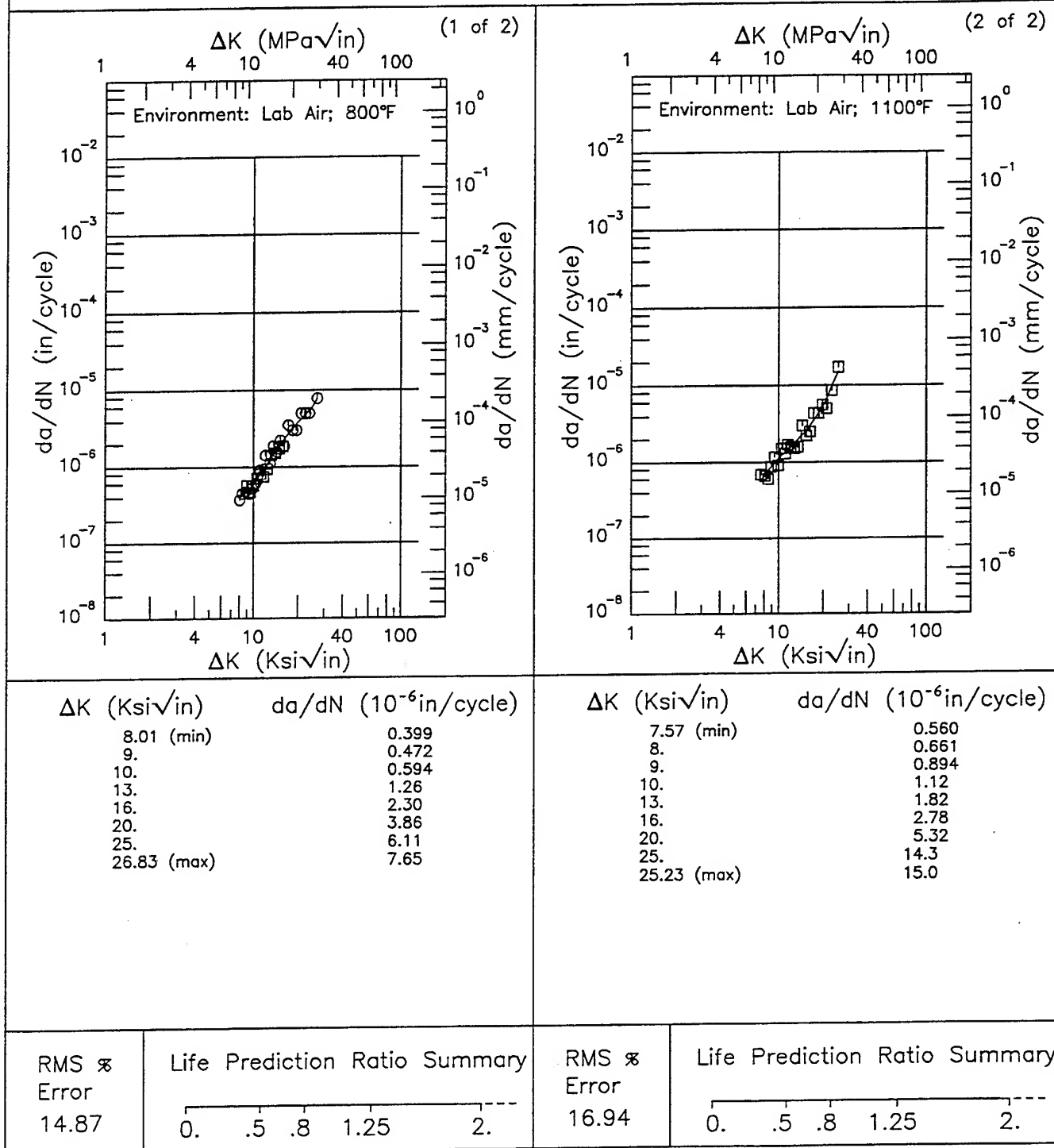


Figure 5.1.3.1.3

Condition/Ht:

Form:

Specimen Type: SENT

Orientation:

Stress Ratio: 0.8

Yield Strength:

Ult. Strength:

Specimen Thk: 0.117 in.

Specimen Width: 2.5 in.

Ref: PW003

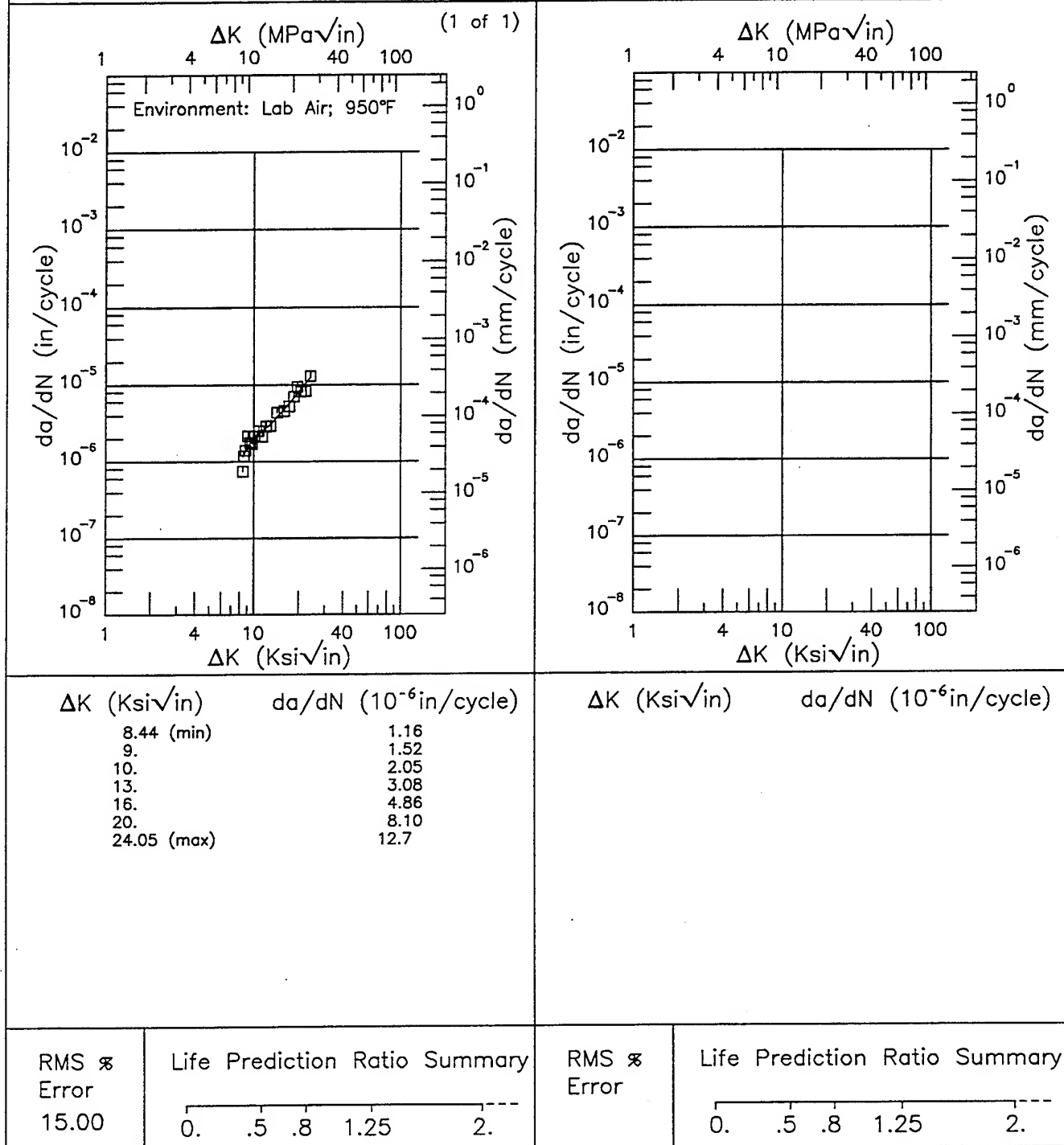


Figure 5.1.3.1.4

EF ASTROLOY 901

Condition/Ht:

Form:

Specimen Type: SENT

Orientation: C-R

Stress Ratio: 0.5

Yield Strength:

Ult. Strength:

Specimen Thk: 0.122 in.

Specimen Width: 2.5 in.

Ref: PW003

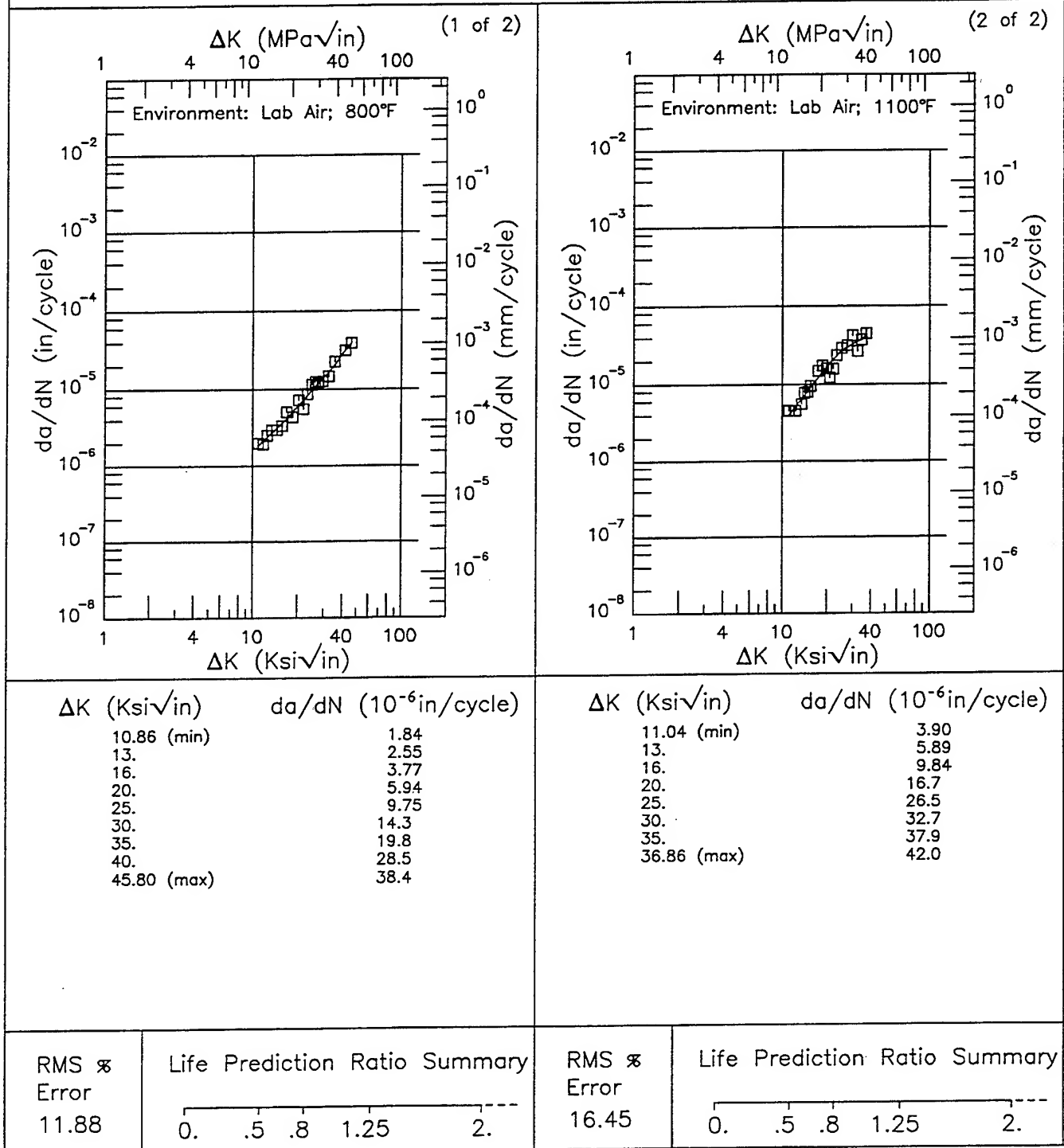


Figure 5.1.3.1.5



**This page intentionally left blank**

F | ASTROLOY P/M-H |

Condition/Ht: 2025F 3HR AC 1600F 8HR AC  
 Form: Disk  
 Specimen Type: WOL  
 Orientation: C-R  
 Stress Ratio: 0.05  
 Environment: LAB AIR;1200°F

Yield Strength: 135.8 ksi  
 Ult. Strength: 202 ksi  
 Specimen Thk: 0.5 in.  
 Specimen Width: 2.5 in.  
 Ref: PW004

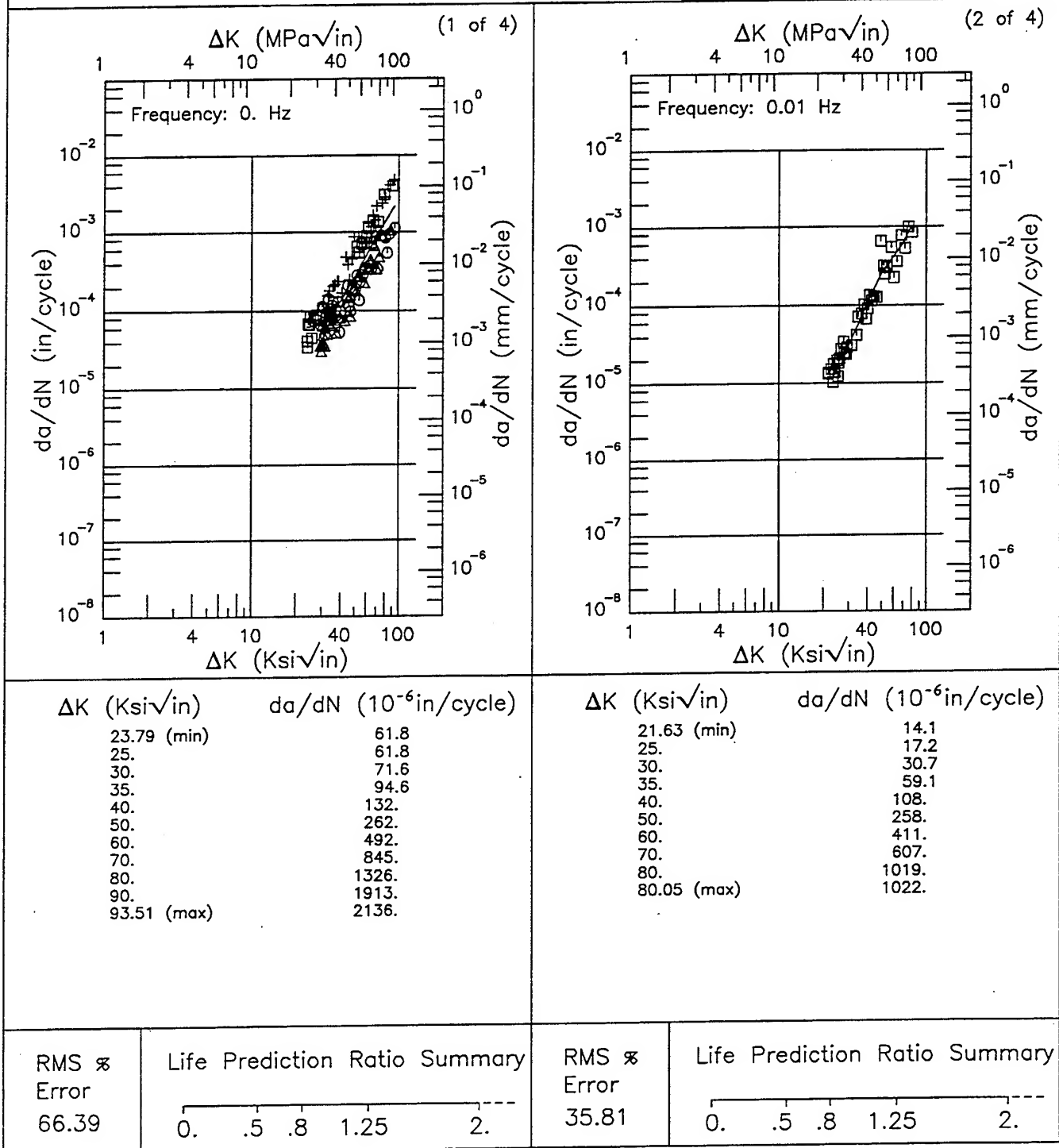


Figure 5.2.3.1

Condition/Ht: 2025F 3HR AC 1600F 8HR AC  
 Form: Disk  
 Specimen Type: WOL  
 Orientation: C-R  
 Stress Ratio: 0.05  
 Environment: LAB AIR;1200°F

Yield Strength: 135.8 ksi  
 Ult. Strength: 202 ksi  
 Specimen Thk: 0.5 in.  
 Specimen Width: 2.5 in.  
 Ref: PW004

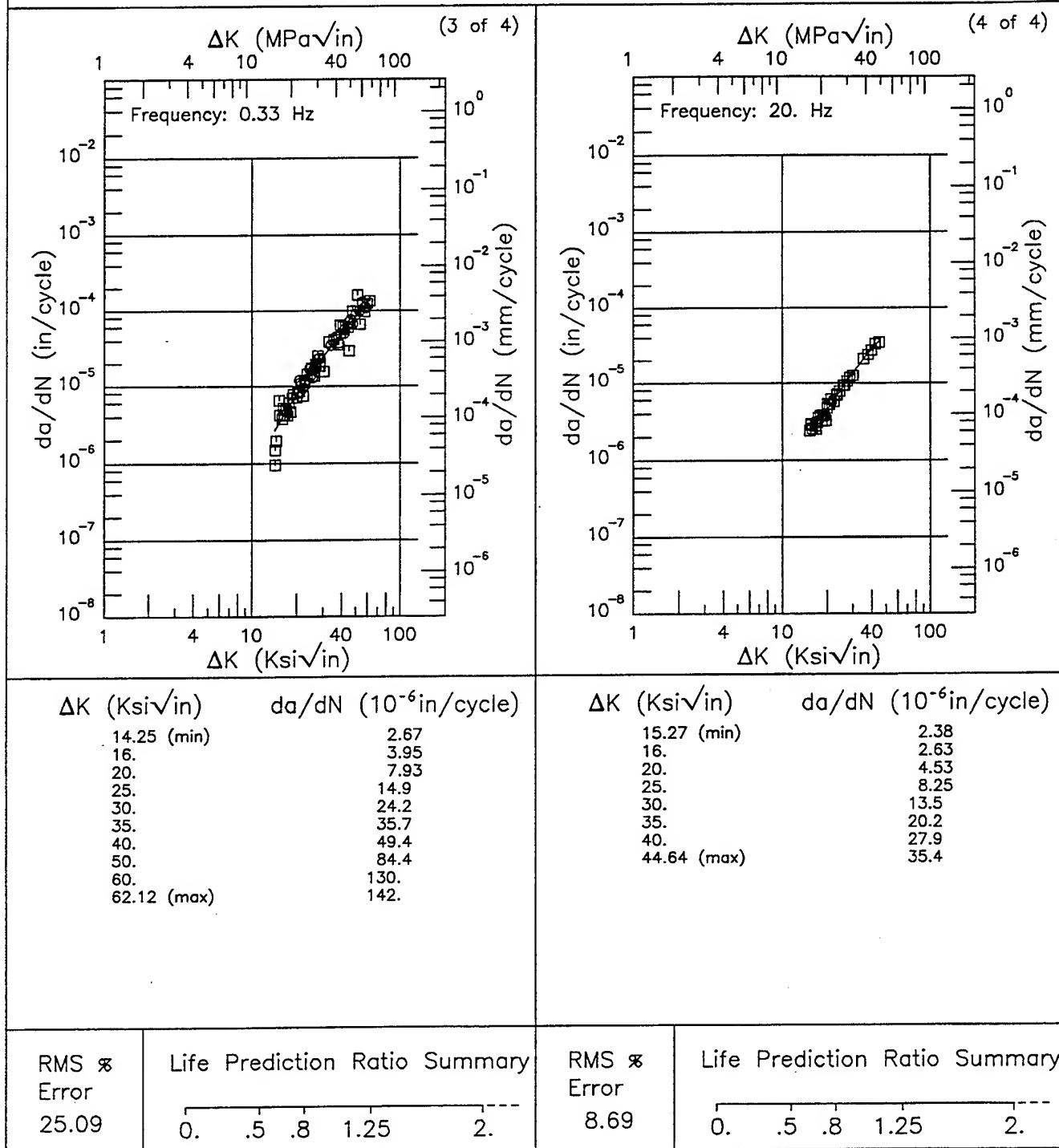
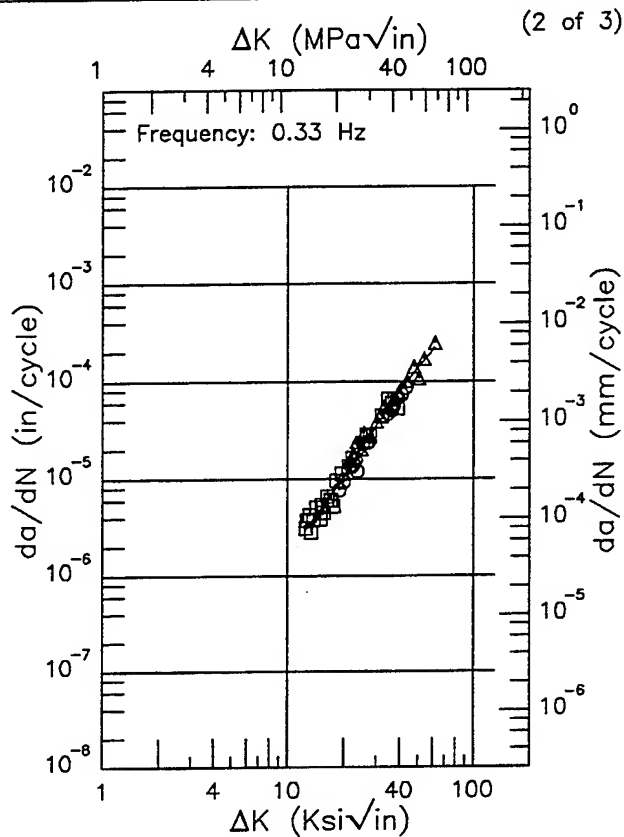
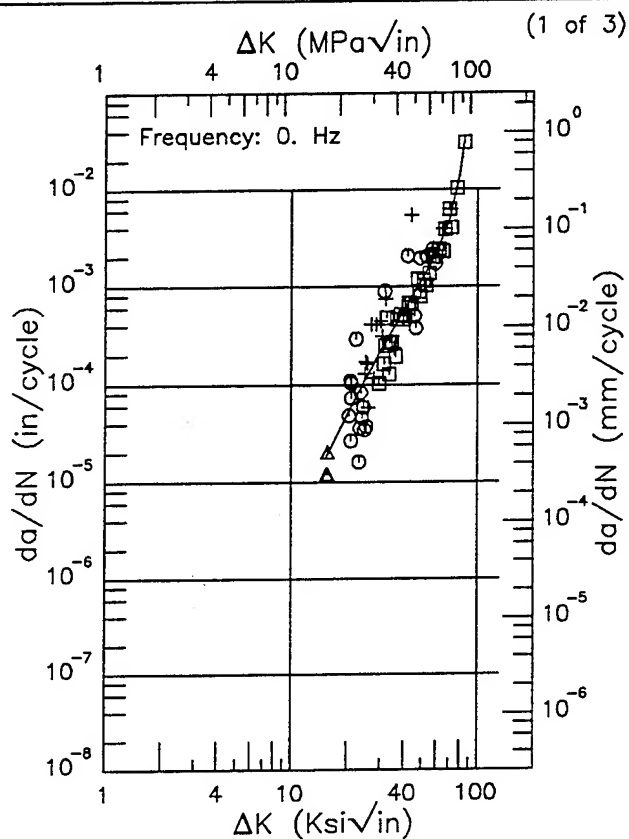


Figure 5.2.3.1 (Concluded)

# ASTROLOY P/M-W

Condition/Ht: 2025F 4HRS AC 1600F 8HRS AC  
 Form: Disk  
 Specimen Type: WOL  
 Orientation: C-R  
 Stress Ratio: 0.05  
 Environment: LAB AIR;1200°F

Yield Strength: 153 ksi  
 Ult. Strength: 220 ksi  
 Specimen Thk: 0.5 in.  
 Specimen Width: 2.5 in.  
 Ref: PW004



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
15.46 (min)	18.4
16.	21.0
20.	49.5
25.	114.
30.	220.
35.	371.
40.	571.
50.	1162.
60.	2199.
70.	4749.
80.	14463.
84.92 (max)	30958.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.48 (min)	2.98
13.	3.29
16.	5.65
20.	10.6
25.	20.6
30.	35.2
35.	54.9
40.	79.4
50.	140.
60.	208.
61.82 (max)	221.

RMS %  
 Error  
 >100.0

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
 Error  
 16.04

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 5.3.3.1

Condition/Ht: 2025F 4HRS AC 1600F 8HRS AC  
 Form: Disk  
 Specimen Type: WOL  
 Orientation: C-R  
 Stress Ratio: 0.05  
 Environment: LAB AIR;1200°F

Yield Strength: 153 ksi  
 Ult. Strength: 220 ksi  
 Specimen Thk: 0.5 in.  
 Specimen Width: 2.5 in.  
 Ref: PW004

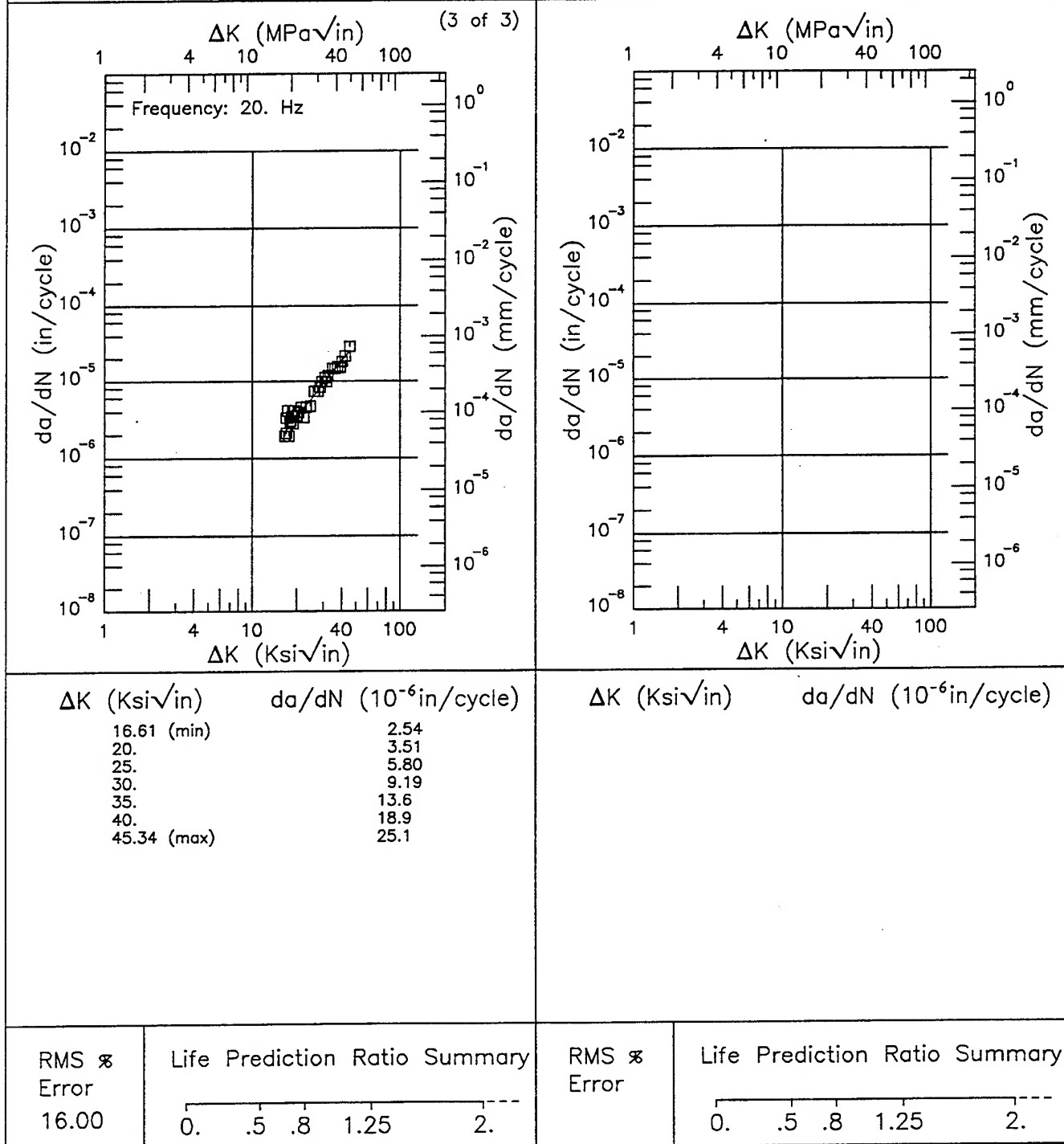


Figure 5.3.3.1 (Concluded)

E IN100

Condition/Ht:

Form:

Specimen Type: CT

Orientation:

Stress Ratio: 0.5

Frequency: 0.2 Hz

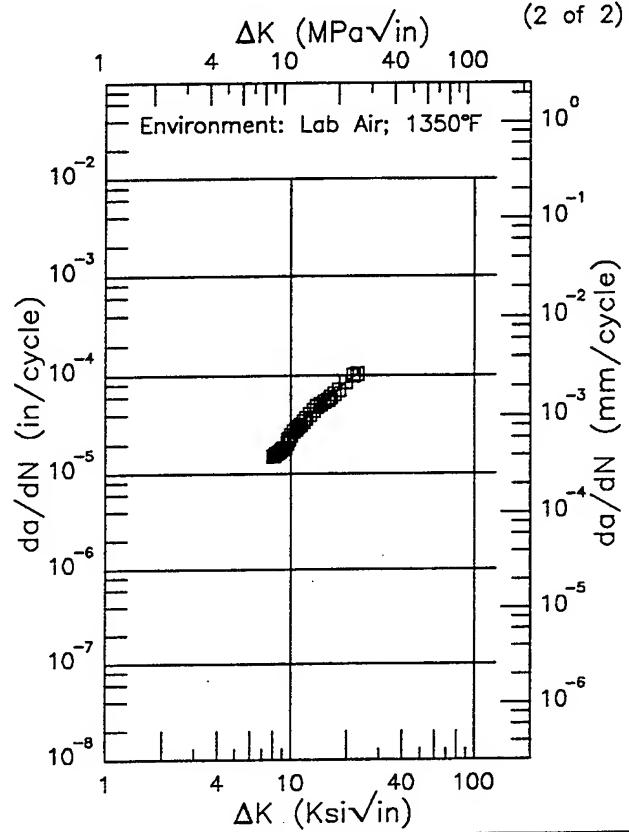
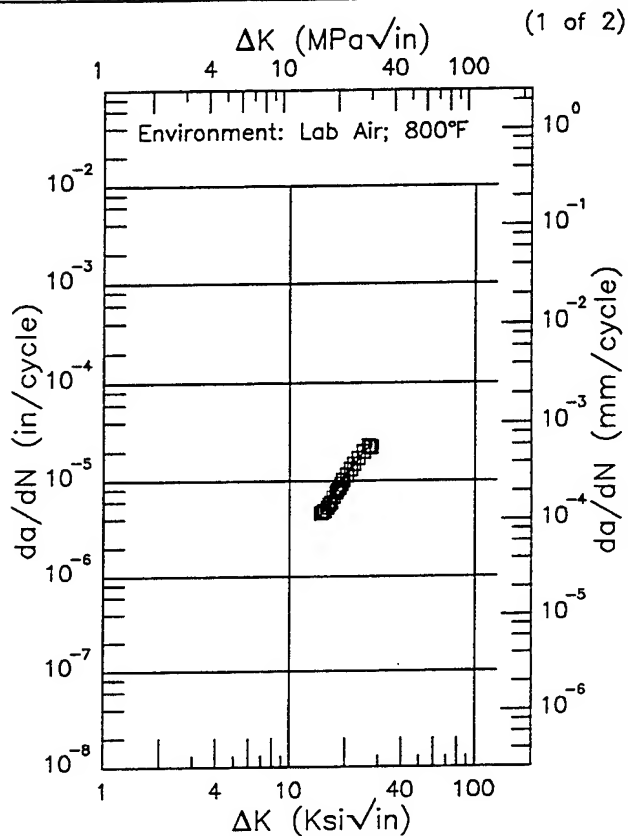
Yield Strength: 169.1 ksi

Ult. Strength: 236.5 ksi

Specimen Thk: 0.401 - 0.5 in.

Specimen Width:

Ref: PW006



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
14.67 (min)	4.32
16.	5.39
20.	10.8
25.	19.8
27.30 (max)	22.9

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
7.98 (min)	14.6
8.	14.7
9.	18.5
10.	23.7
13.	43.0
16.	57.7
20.	87.0
22.70 (max)	102.

RMS %  
Error  
2.50

Life Prediction Ratio Summary  
0. .5 .8 1.25 2. ---

RMS %  
Error  
2.79

Life Prediction Ratio Summary  
0. .5 .8 1.25 2. ---

Figure 5.4.3.1.1

Condition/Ht:

Form:

Specimen Type: CT

Orientation: C-R

Frequency: 0.3 Hz

Environment: LAB AIR;1200°F

Yield Strength: 169.1 ksi

Ult. Strength: 236.5 ksi

Specimen Thk: 0.5 in.

Specimen Width:

Ref: PW006

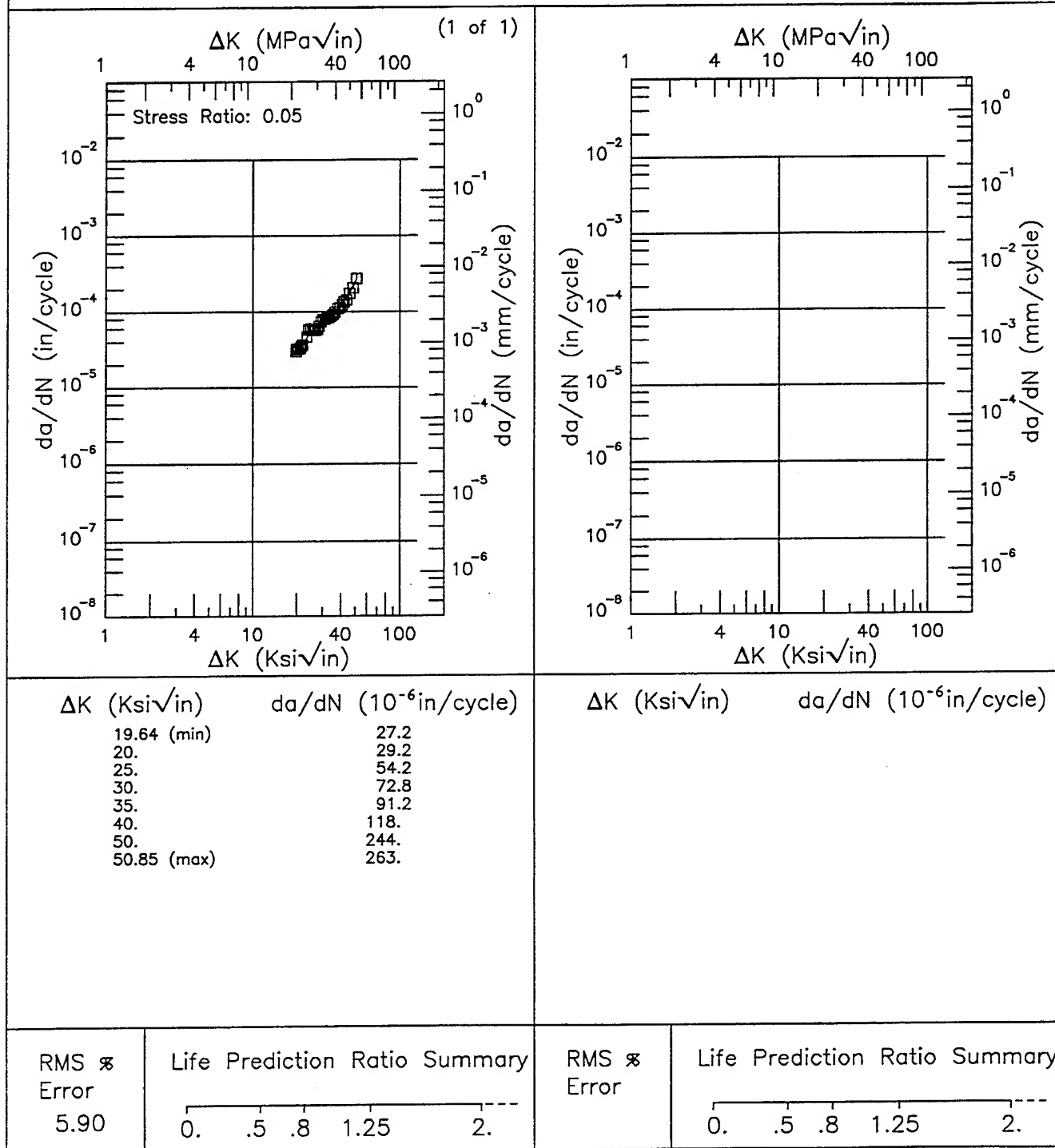


Figure 5.4.3.1.2

R

IN100

Condition/Ht:

Form:

Specimen Type: CT

Orientation: C-R

Frequency: 0.3 Hz

Environment: LAB AIR;1200°F

Yield Strength: 169.1 ksi

Ult. Strength: 236.5 ksi

Specimen Thk: 0.826 in.

Specimen Width:

Ref: PW006

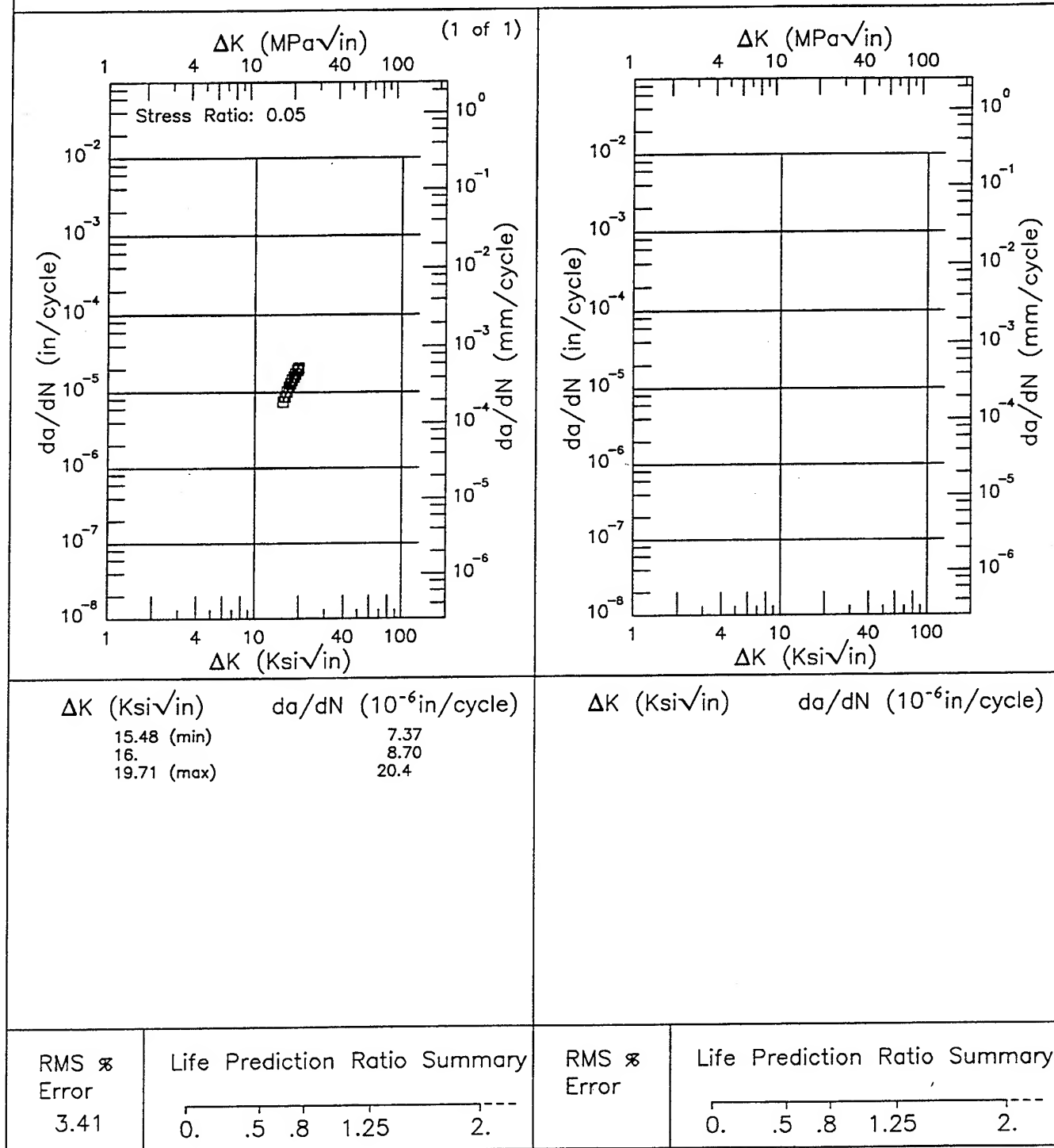


Figure 5.4.3.1.3



Condition/Ht:  
Form:  
Specimen Type: CT  
Orientation: C-R  
Frequency: 20 Hz  
Environment: LAB AIR;800°F

Yield Strength: 169.1 ksi  
Ult. Strength: 236.5 ksi  
Specimen Thk: 0.5 in.  
Specimen Width:  
Ref: PW006

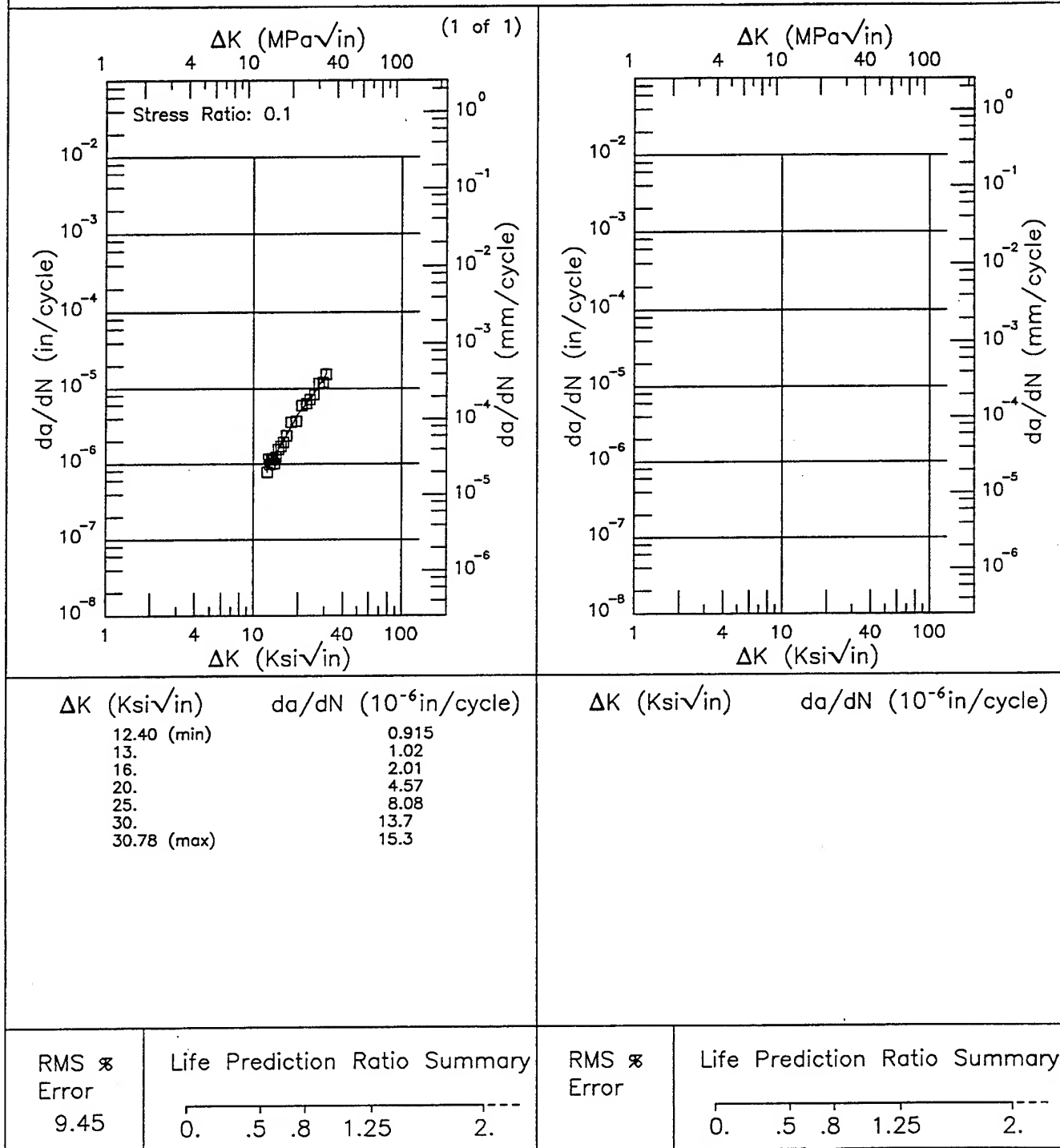


Figure 5.4.3.1.4

H IN100 H

Condition/Ht:

Form:

Specimen Type: CT

Orientation: C-R

Frequency: 20 Hz

Environment: LAB AIR;1200°F

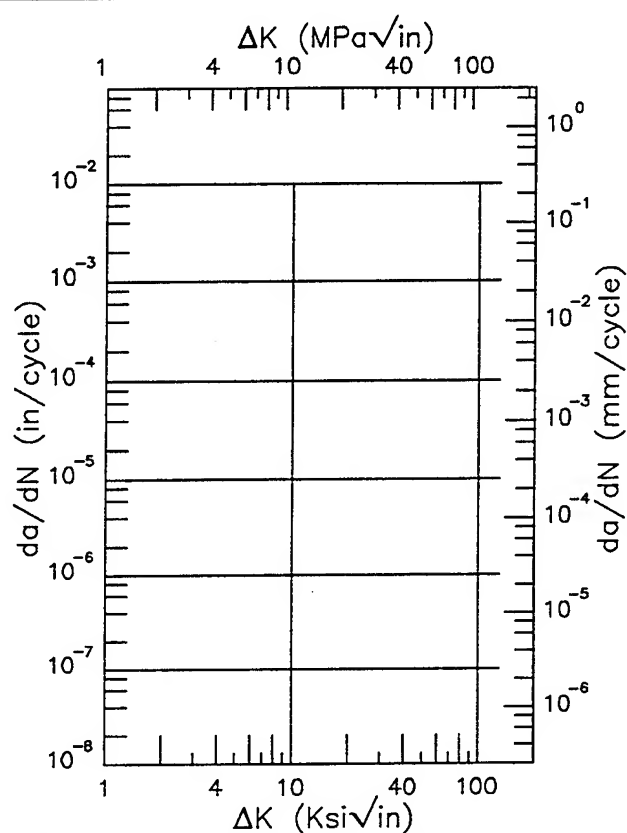
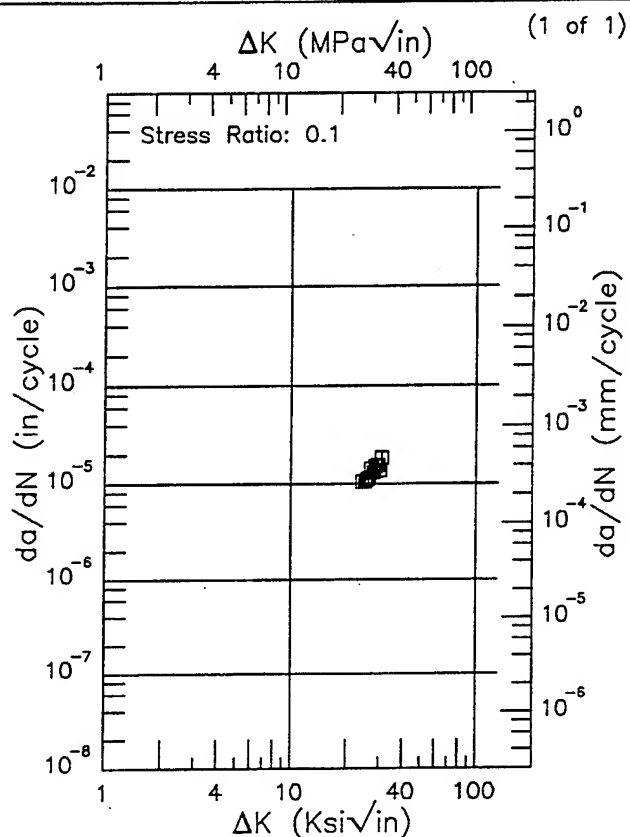
Yield Strength: 169.1 ksi

Ult. Strength: 236.5 ksi

Specimen Thk: 0.108 in.

Specimen Width:

Ref: PW006

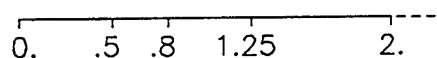


$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
24.21 (min)	10.0
25.	10.6
30.	15.5
30.86 (max)	15.9

$$\Delta K \text{ (Ksi}\sqrt{\text{in}}) \quad da/dN \text{ (10}^{-6}\text{in/cycle)}$$

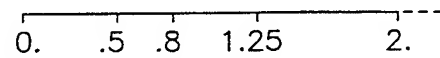
RMS Error  
8.06

### Life Prediction Ratio Summary



RMS Error

### Life Prediction Ratio Summary



**Figure 5.4.3.1.5**

Condition/Ht:  
 Form:  
 Specimen Type: CT  
 Orientation: C-R  
 Frequency: 0. Hz  
 Environment: LAB AIR;1100°F

Yield Strength: 169.1 ksi  
 Ult. Strength: 236.5 ksi  
 Specimen Thk: 0.251 in.  
 Specimen Width:  
 Ref: PW006

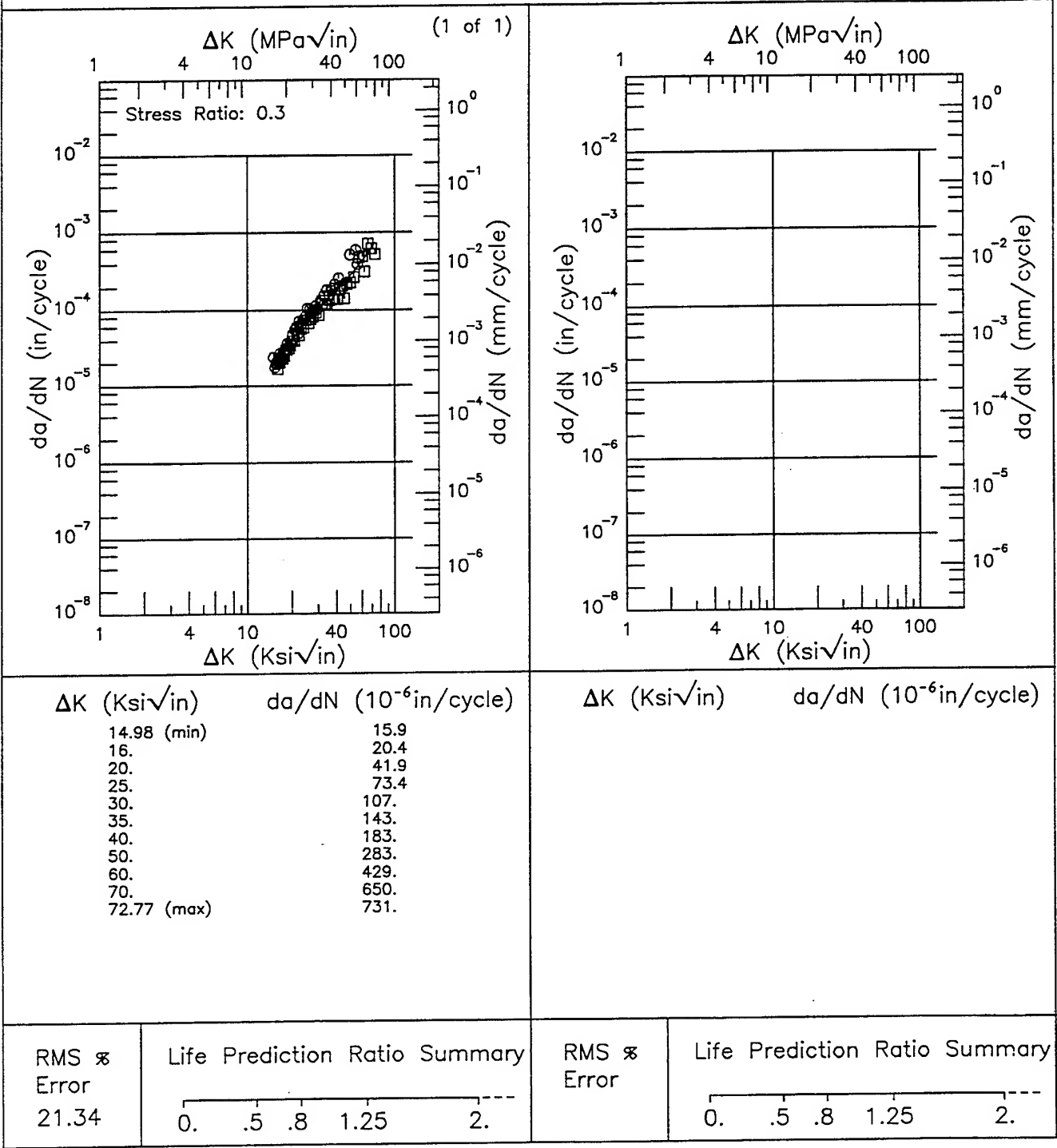


Figure 5.4.3.1.6

E IN100

Condition/Ht:

Form:

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.1

Frequency:

Yield Strength: 169.1 ksi

Ult. Strength: 236.5 ksi

Specimen Thk: 0.246 - 0.461 in.

Specimen Width:

Ref: PW006

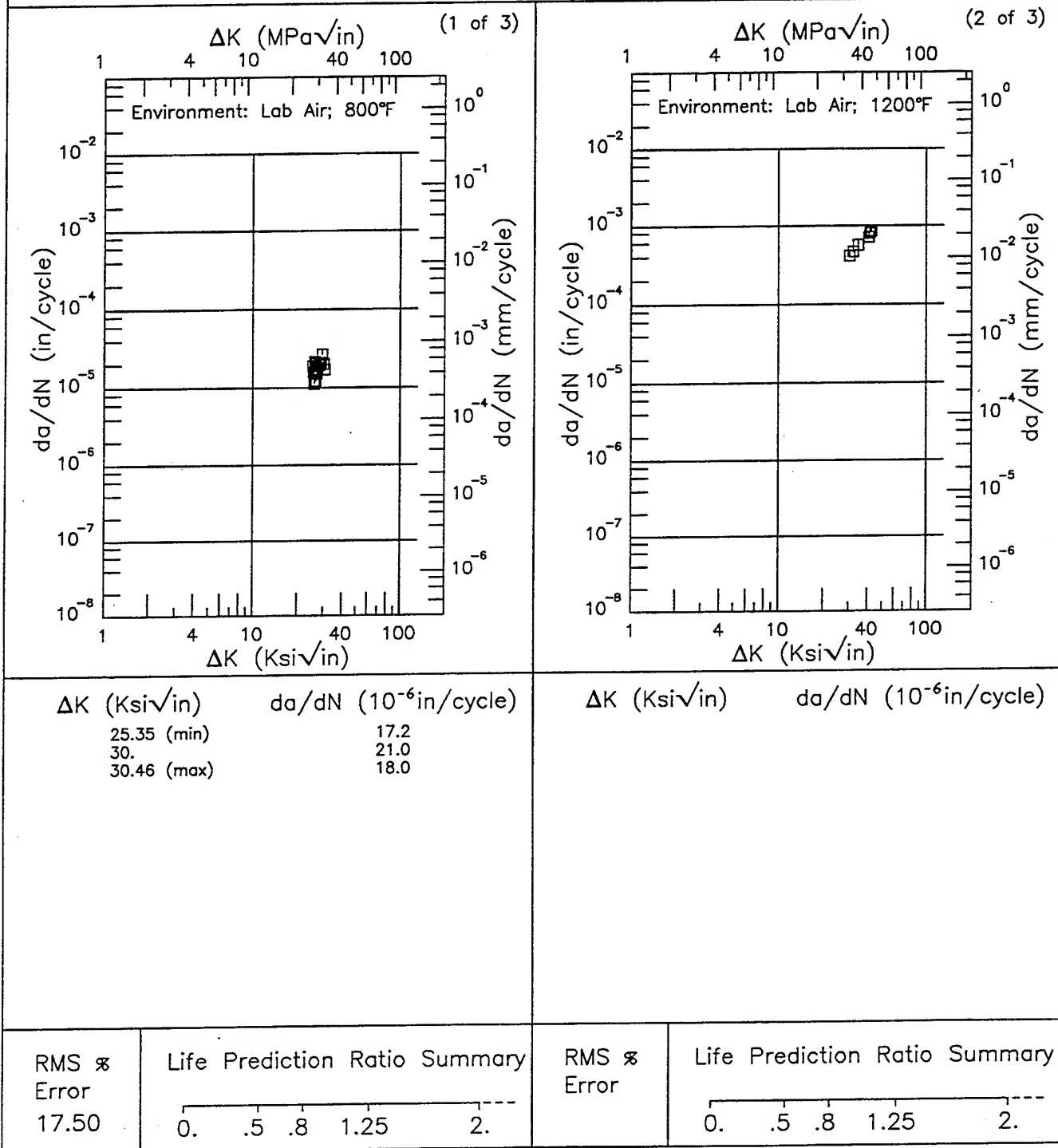


Figure 5.4.3.1.7

Condition/Ht:

Form:

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.1

Frequency:

Yield Strength: 169.1 ksi

Ult. Strength: 236.5 ksi

Specimen Thk: 0.246 - 0.461 in.

Specimen Width:

Ref: PW006

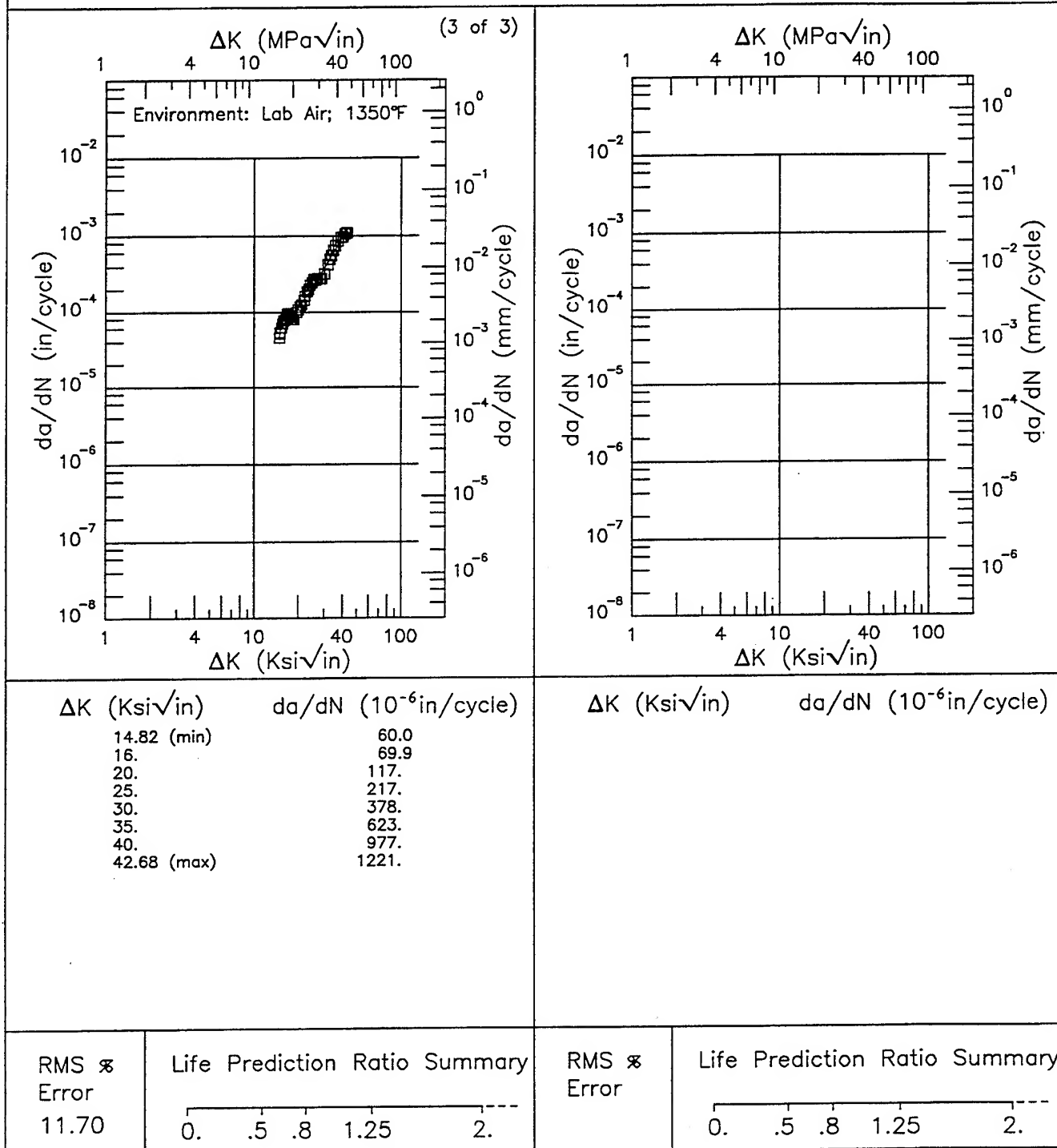


Figure 5.4.3.1.7 (Concluded)

IN100

Condition/Ht:

Form:

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.1

Frequency: 0.2 Hz

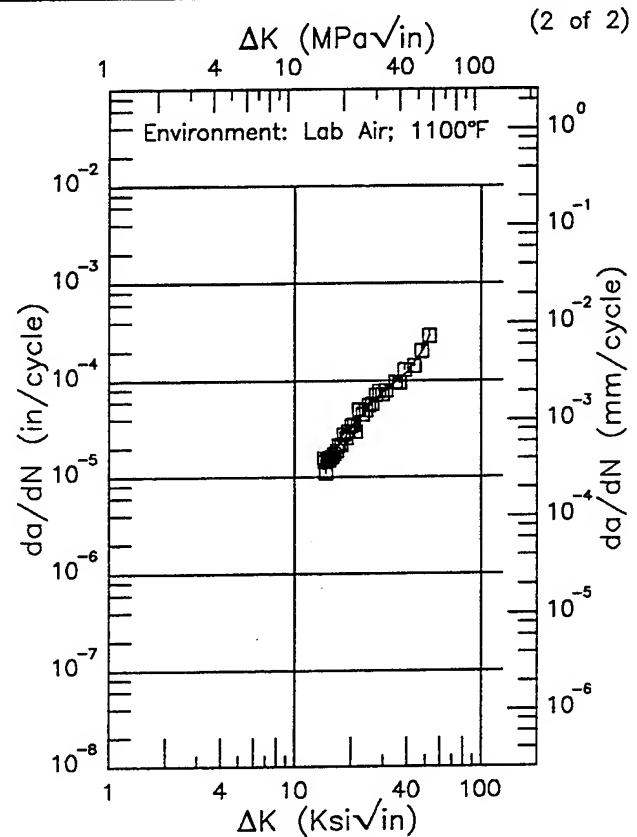
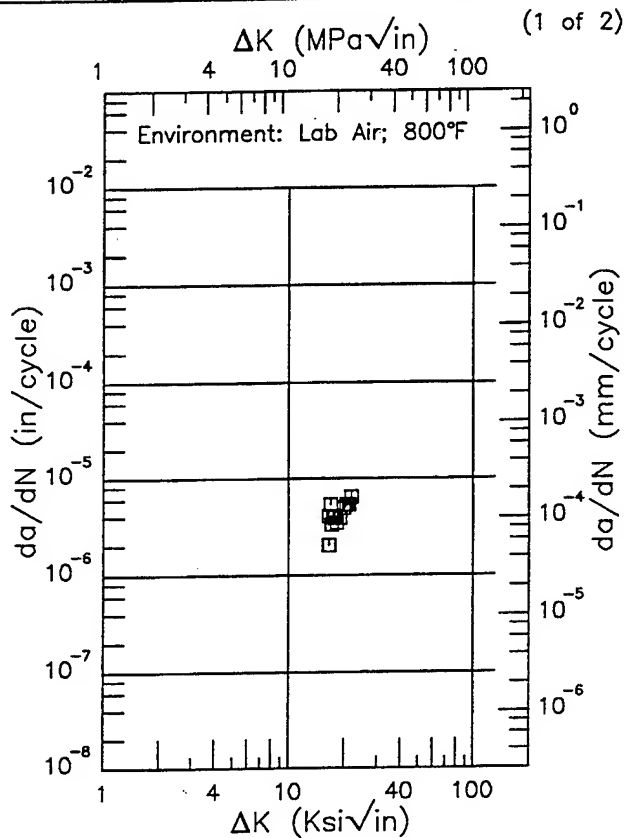
Yield Strength: 169.1 ksi

Ult. Strength: 236.5 ksi

Specimen Thk: 0.5 in.

Specimen Width:

Ref: PW006



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
16.43 (min)	3.24
20.	4.71
21.80 (max)	6.30

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
14.26 (min)	12.0
16.	17.0
20.	31.7
25.	54.1
30.	77.7
35.	99.7
40.	123.
50.	227.
52.90 (max)	293.

RMS %  
Error  
22.81

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
9.91

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 5.4.3.1.8

Condition/Ht:

Form:

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.1

Frequency: 0.2 Hz

Yield Strength: 169.1 ksi

Ult. Strength: 236.5 ksi

Specimen Thk: 0.25 in.

Specimen Width:

Ref: PW006

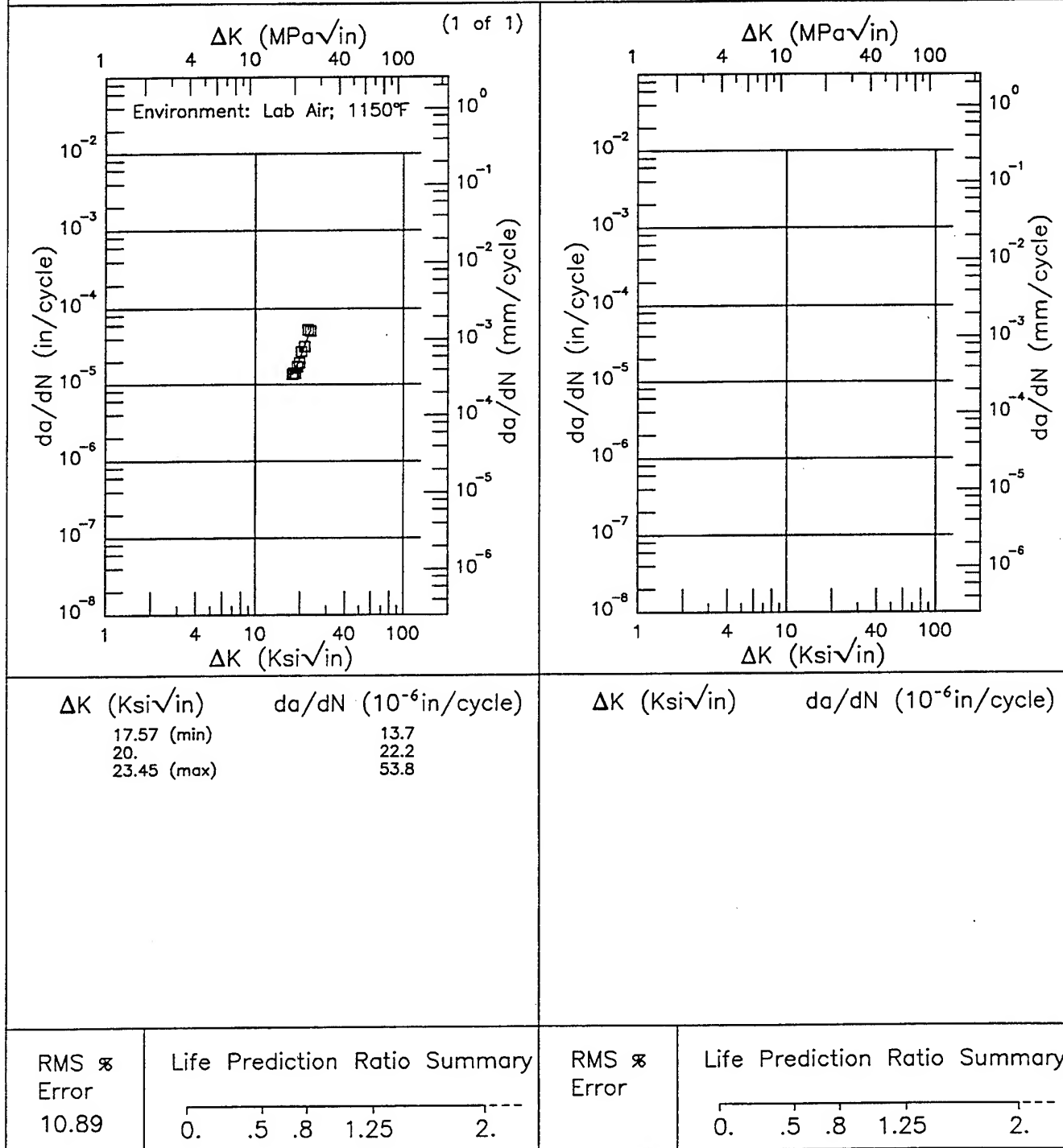


Figure 5.4.3.1.9

E IN100

Condition/Ht:  
Form:  
Specimen Type: CT  
Orientation: C-R  
Stress Ratio: 0.1  
Frequency: 30 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk: 0.5 in.  
Specimen Width: 2.5 in.  
Ref: PW003

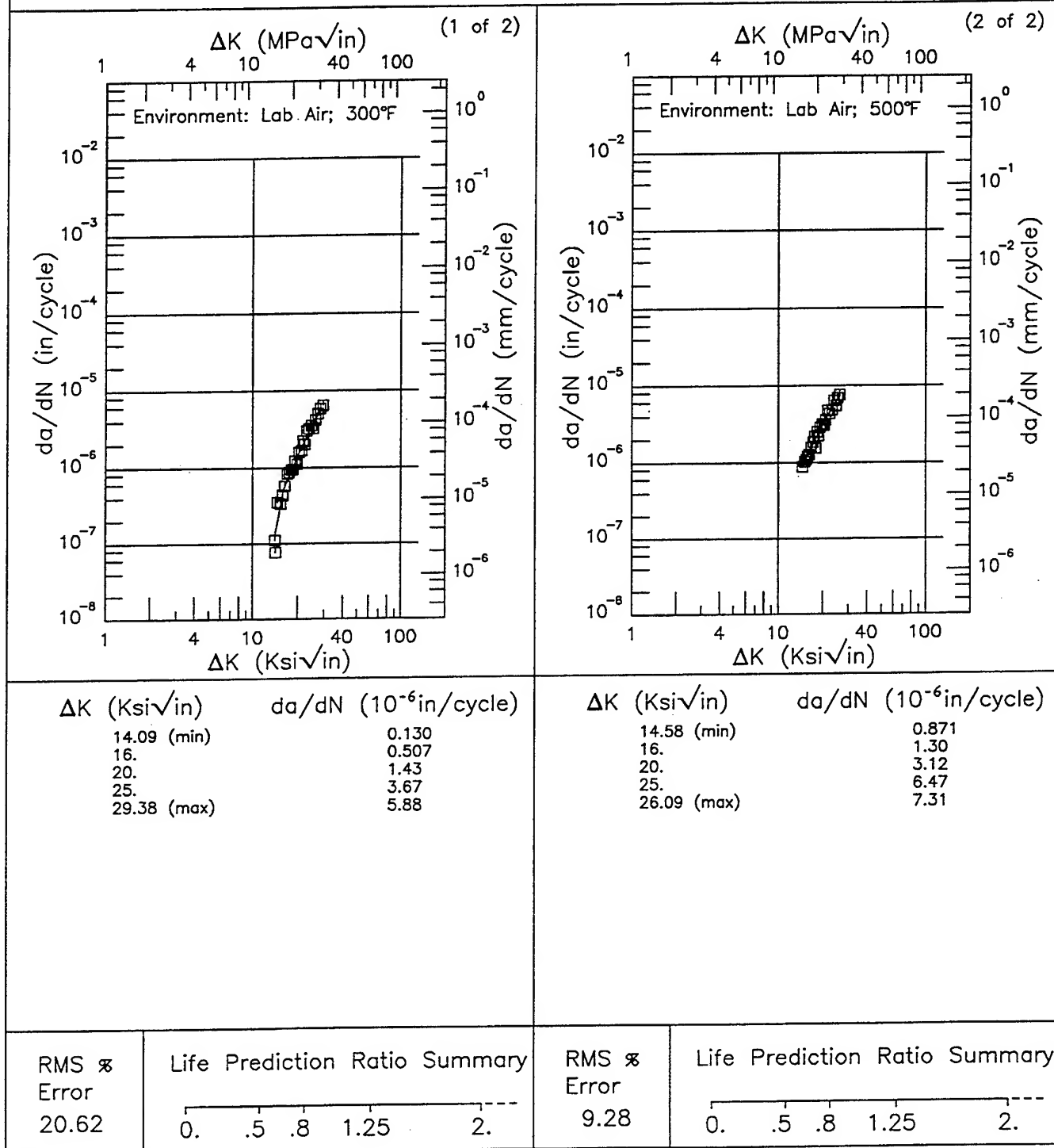


Figure 5.4.3.1.10



Condition/Ht:  
 Form: 1.6 in. Forging  
 Specimen Type: CT  
 Orientation:  
 Frequency: 0.2 Hz  
 Environment: LAB AIR;1200°F

Yield Strength: 169.1 ksi  
 Ult. Strength: 236.5 ksi  
 Specimen Thk: 0.252 - 0.302 in.  
 Specimen Width: 2.503 - 2.504 in.  
 Ref: PW002

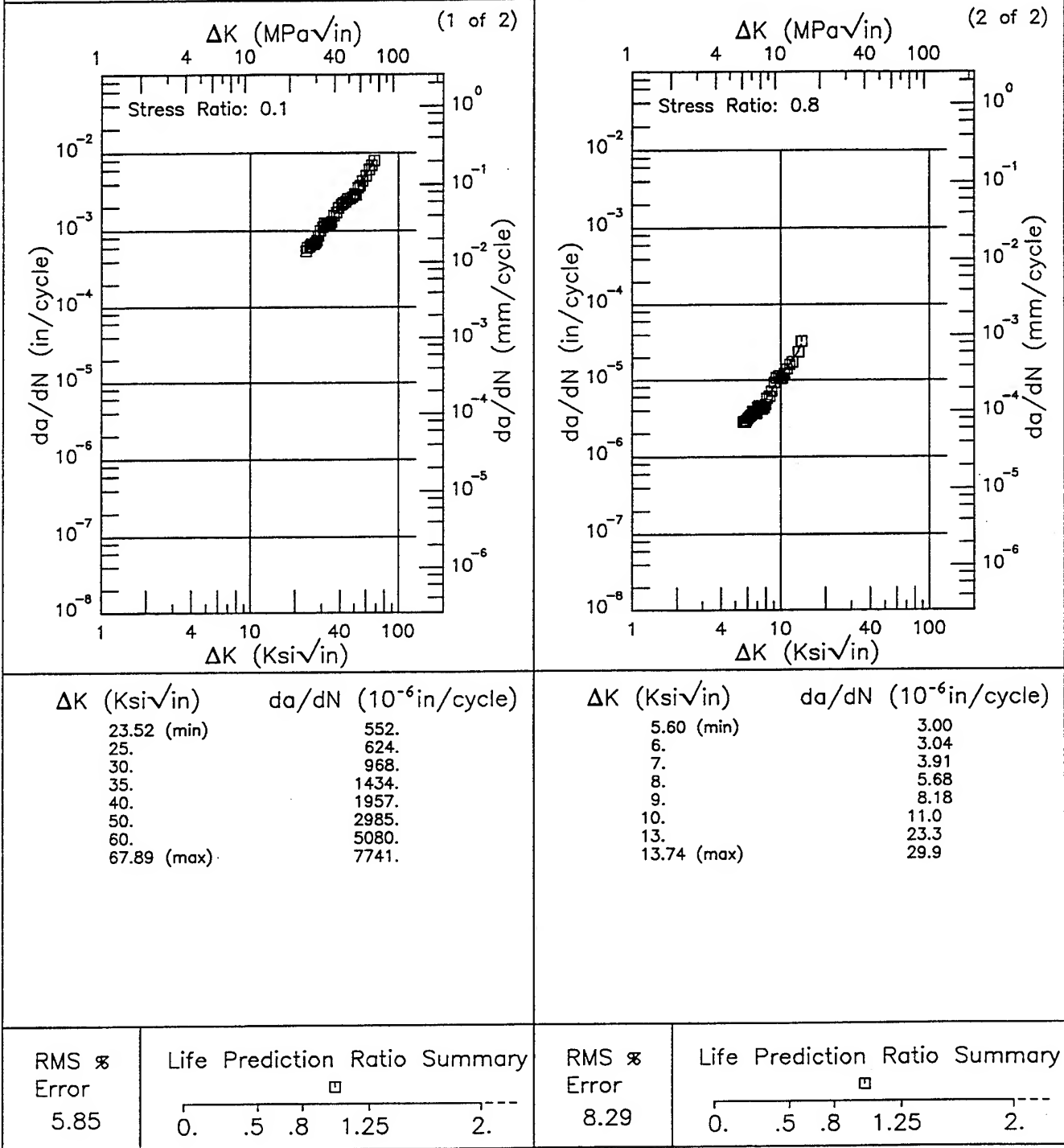
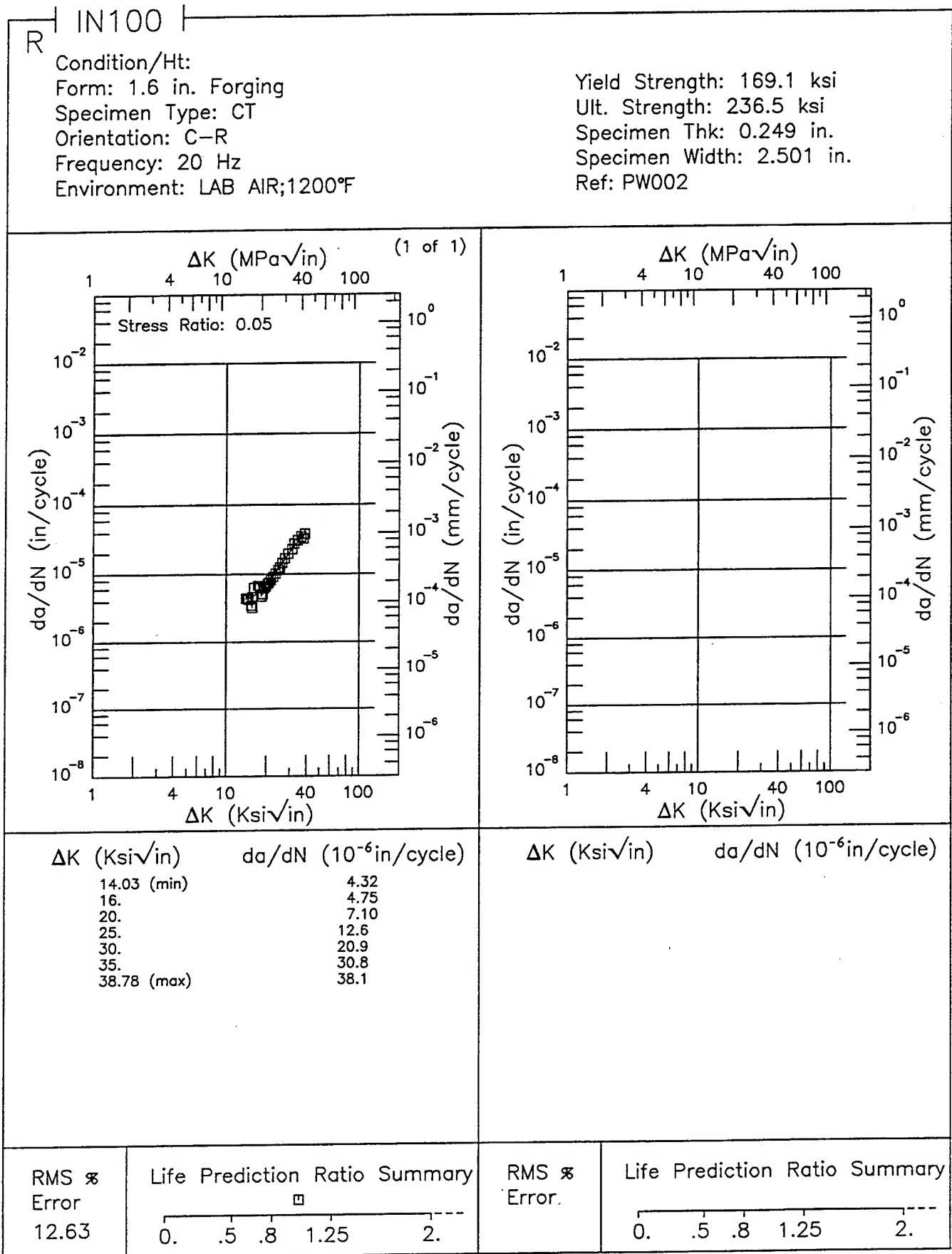


Figure 5.4.3.1.11



**Figure 5.4.3.1.12**

Condition/Ht:  
Form: 1.6 in. Forging  
Specimen Type: CT  
Orientation: C-R  
Frequency: 20 Hz  
Environment: LAB AIR;1200°F

Yield Strength: 169.1 ksi  
Ult. Strength: 236.5 ksi  
Specimen Thk: 0.206 - 0.442 in.  
Specimen Width: 2.494 - 2.508 in.  
Ref: PW002

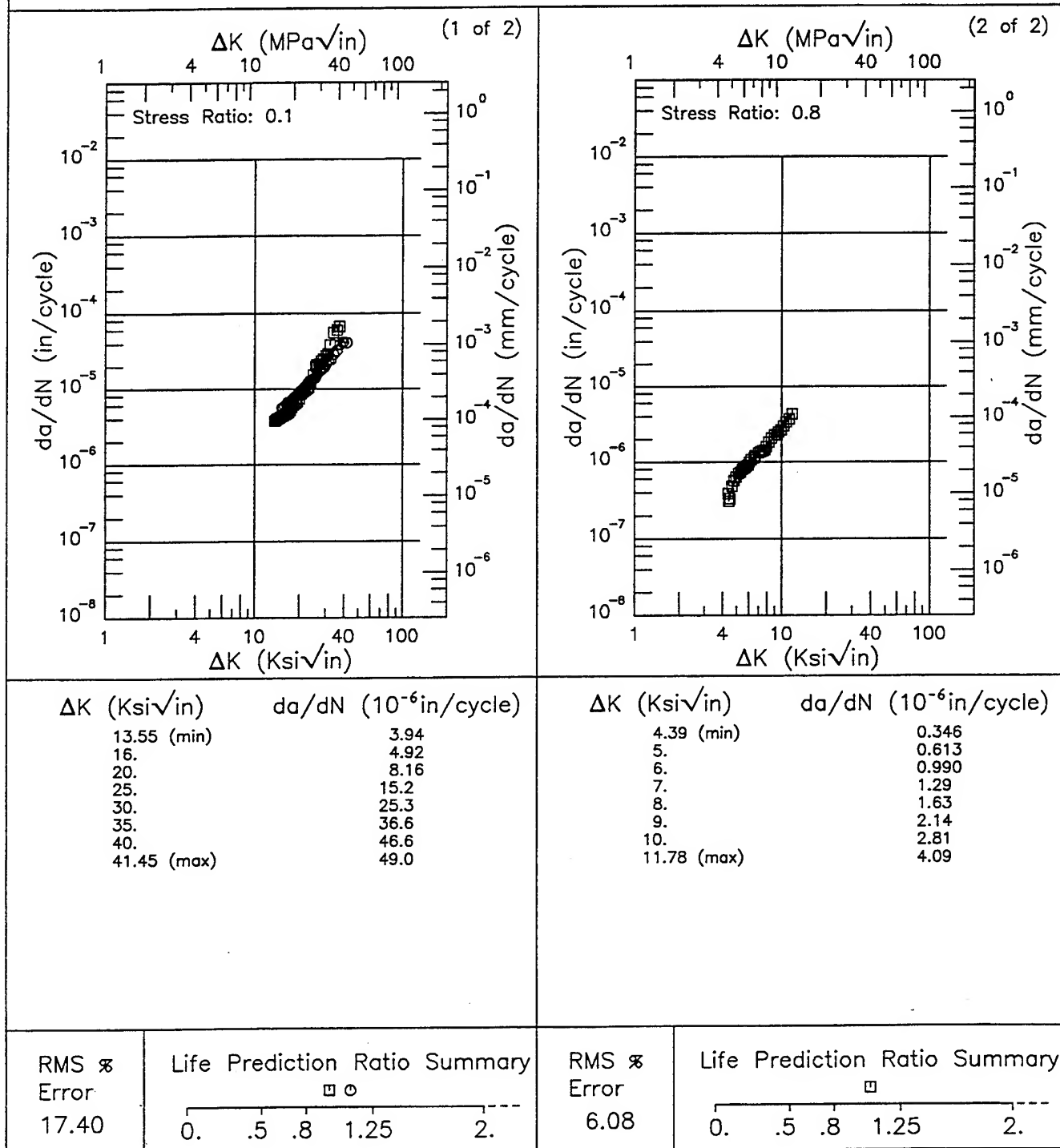
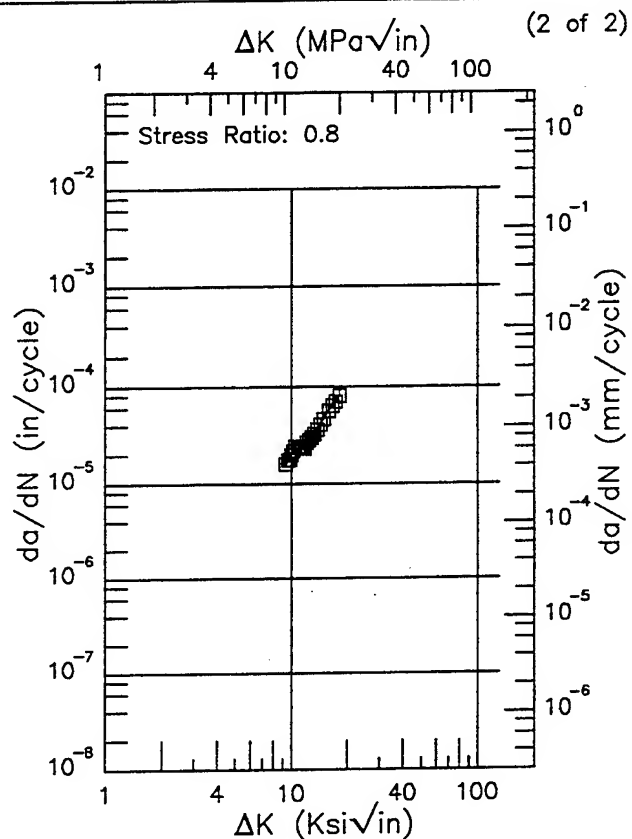
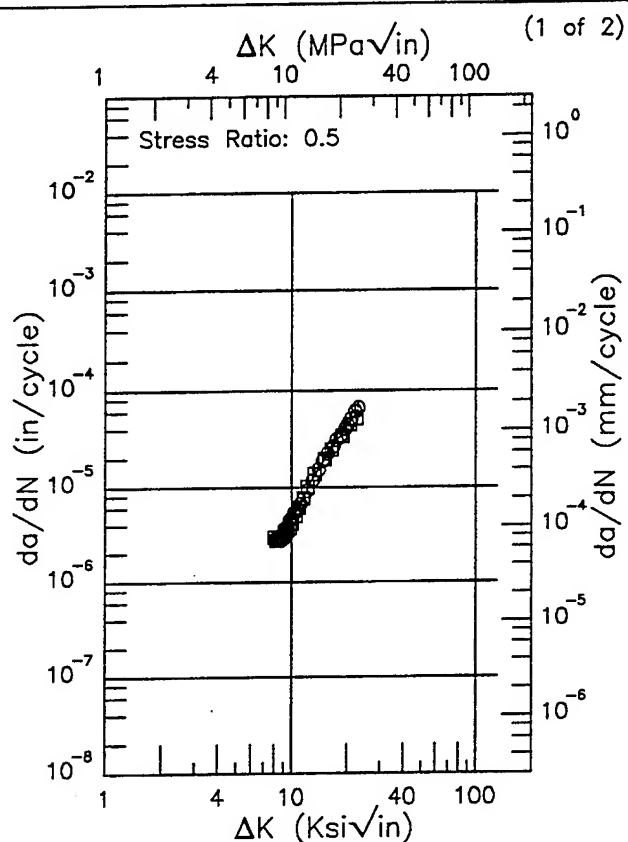


Figure 5.4.3.1.13

R IN100

Condition/Ht:  
Form: 1.6 in. Forging  
Specimen Type: CT  
Orientation: C-R  
Frequency: 0.2 Hz  
Environment: LAB AIR;1200°F

Yield Strength: 169.1 ksi  
Ult. Strength: 236.5 ksi  
Specimen Thk: 0.5 - 0.503 in.  
Specimen Width: 2.496 - 2.505 in.  
Ref: PW002



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
8.06 (min)	2.69
9.	3.22
10.	4.41
13.	12.1
16.	23.2
20.	43.0
22.91 (max)	62.8

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
9.28 (min)	15.4
10.	20.4
13.	30.3
16.	57.3
18.16 (max)	80.1

RMS %  
Error  
5.87

Life Prediction Ratio Summary

□

0. .5 .8 1.25 2.

RMS %  
Error  
4.32

Life Prediction Ratio Summary

□

0. .5 .8 1.25 2.

Figure 5.4.3.1.14

Condition/Ht:  
 Form: 1.6 in. Forging  
 Specimen Type: CT  
 Orientation: C-R  
 Stress Ratio: 0.1  
 Frequency:

Yield Strength: 169.1 ksi  
 Ult. Strength: 236.5 ksi  
 Specimen Thk: 0.25 - 0.856 in.  
 Specimen Width: 2.436 - 2.51 in.  
 Ref: PW002

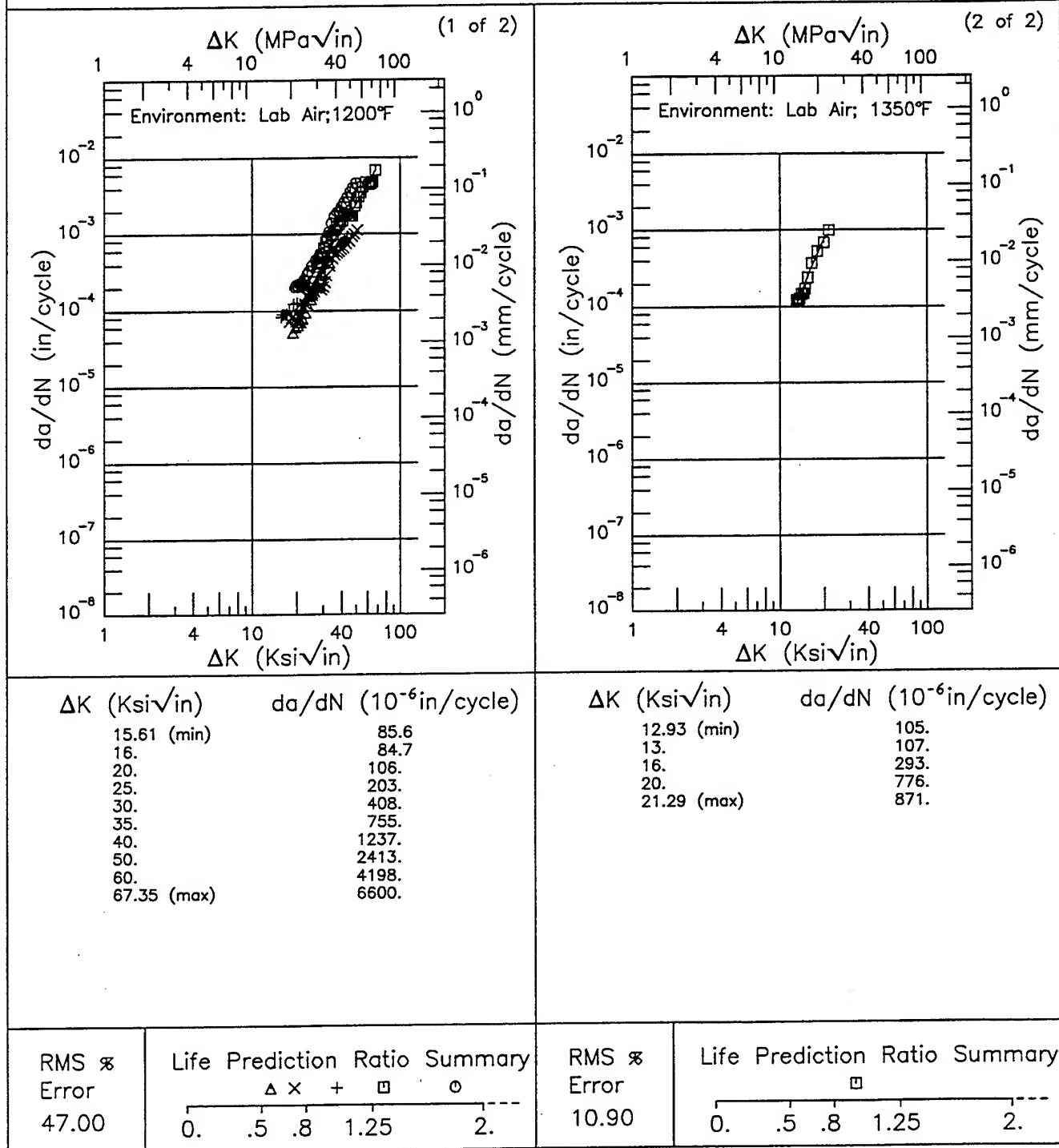
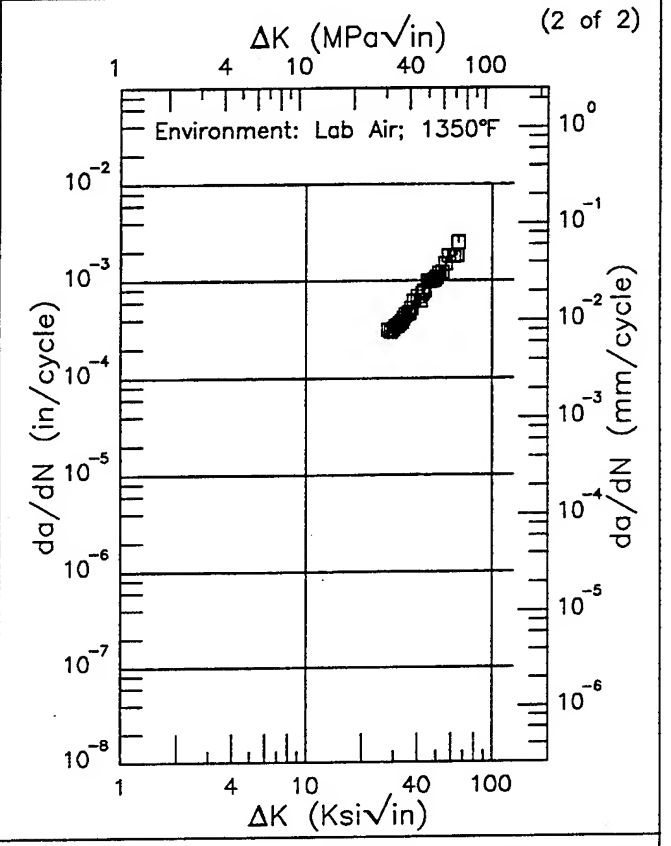
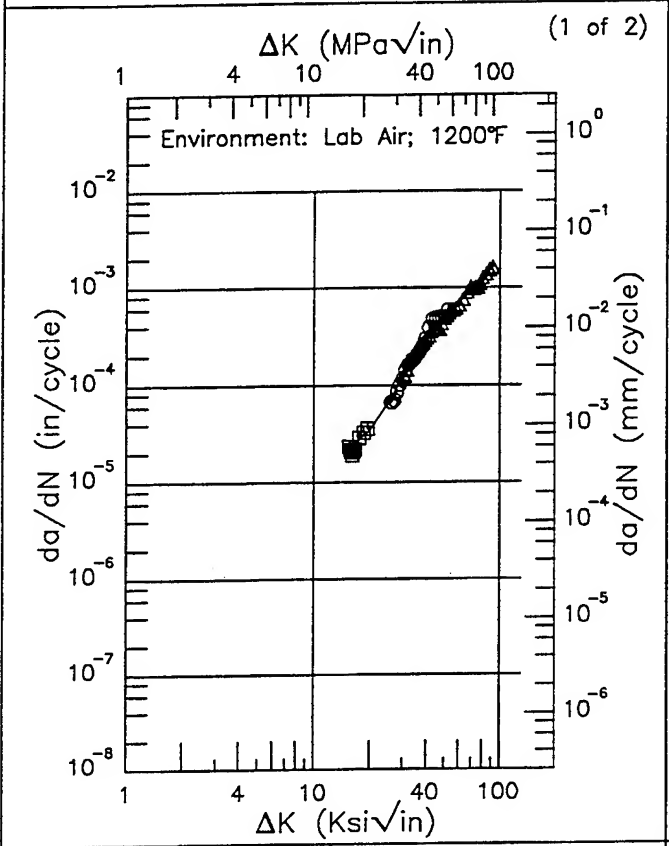


Figure 5.4.3.1.15

E IN100

Condition/Ht:  
 Form: 1.6 in. Forging  
 Specimen Type: CT  
 Orientation: C-R  
 Stress Ratio: 0.1  
 Frequency: 0. Hz

Yield Strength: 169.1 ksi  
 Ult. Strength: 236.5 ksi  
 Specimen Thk: 0.25 - 0.469 in.  
 Specimen Width: 2.437 - 2.511 in.  
 Ref: PW006;PW002



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
15.43 (min)	22.7
16.	23.4
20.	34.7
25.	65.7
30.	120.
35.	199.
40.	295.
50.	497.
60.	700.
70.	927.
80.	1207.
90.	1569.
91.39 (max)	1628.

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
27.86 (min)	281.
30.	322.
35.	452.
40.	630.
50.	1117.
60.	1699.
65.70 (max)	2019.

RMS % Error	Life Prediction Ratio Summary
9.35	

RMS % Error	Life Prediction Ratio Summary
6.80	

Figure 5.4.3.1.16

**This page intentionally left blank**

E IN100

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.1

Frequency: 0.2 Hz

Yield Strength: 169.1 ksi

Ult. Strength: 236.5 ksi

Specimen Thk: 0.25 - 0.87 in.

Specimen Width: 2.493 - 2.511 in.

Ref: PW002;PW006

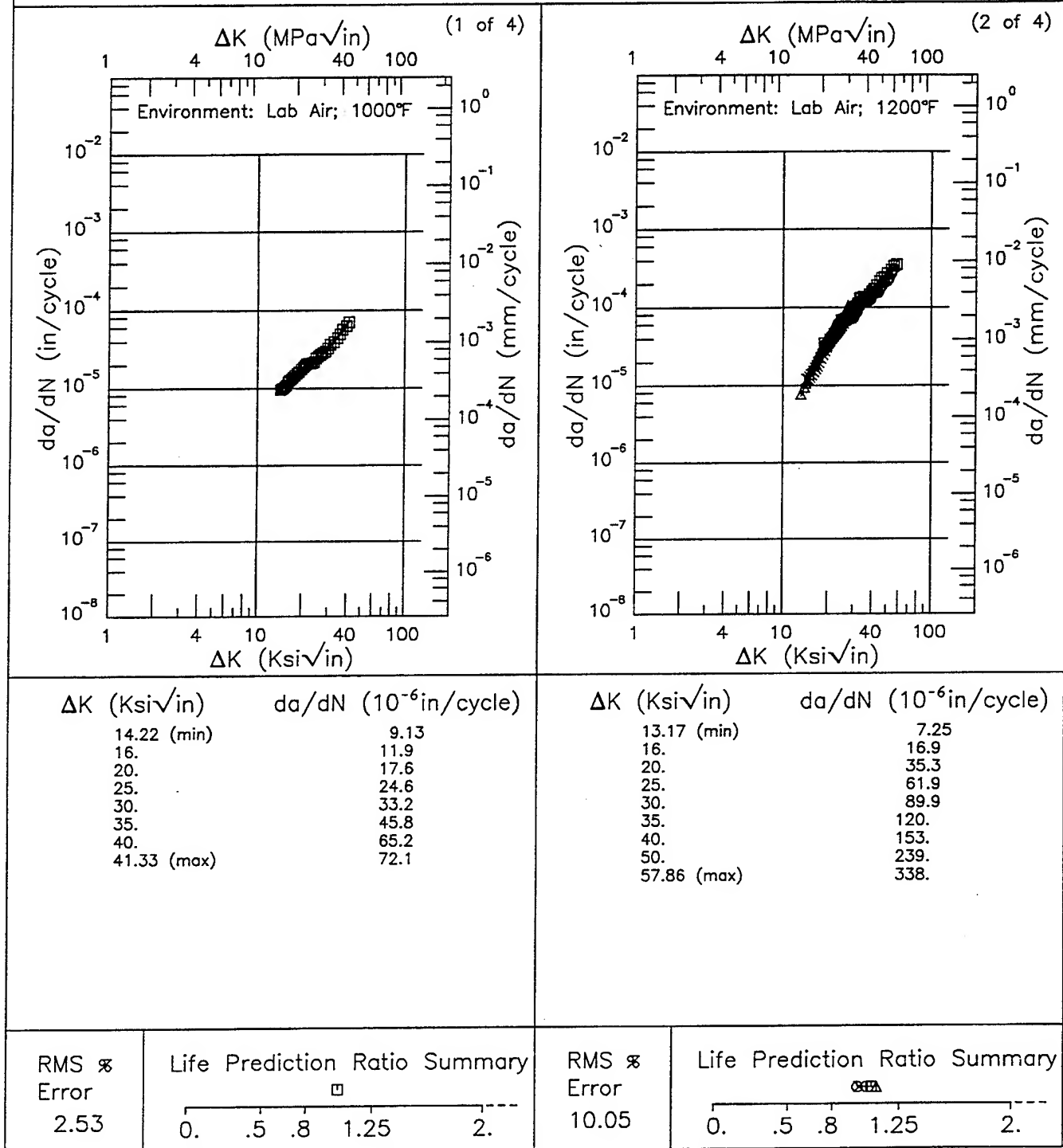


Figure 5.4.3.1.17



Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.1

Frequency: 0.2 Hz

Yield Strength: 169.1 ksi

Ult. Strength: 236.5 ksi

Specimen Thk: 0.25 - 0.87 in.

Specimen Width: 2.493 - 2.511 in.

Ref: PW002;PW006

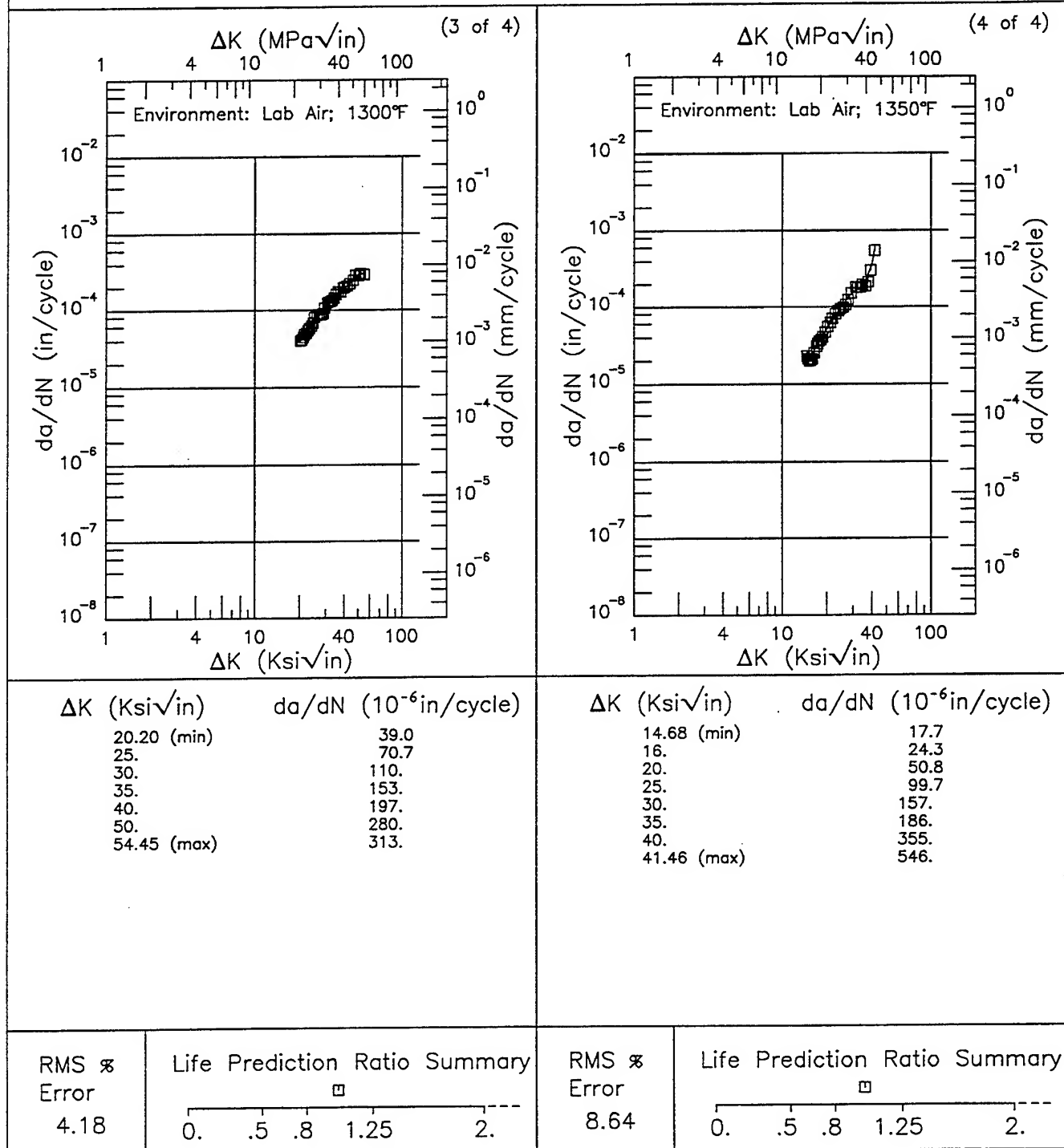
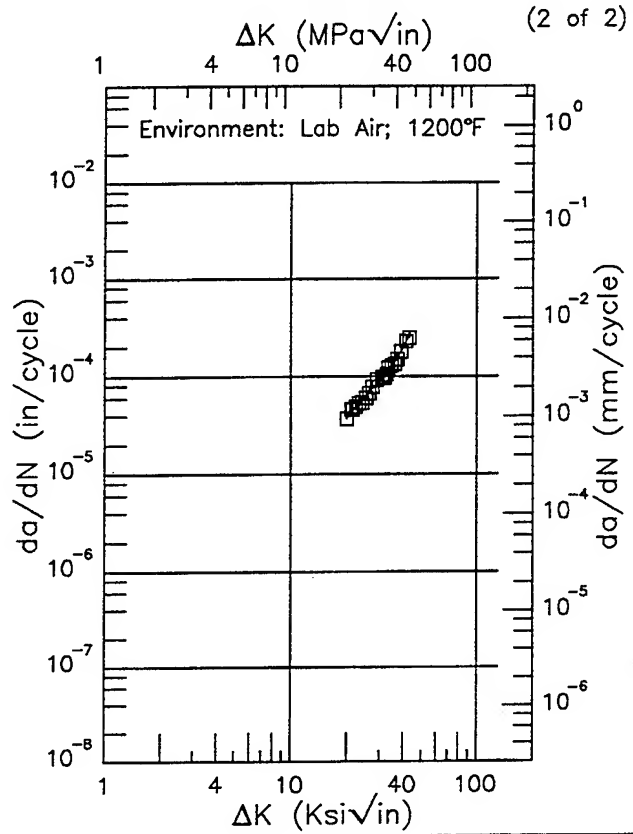
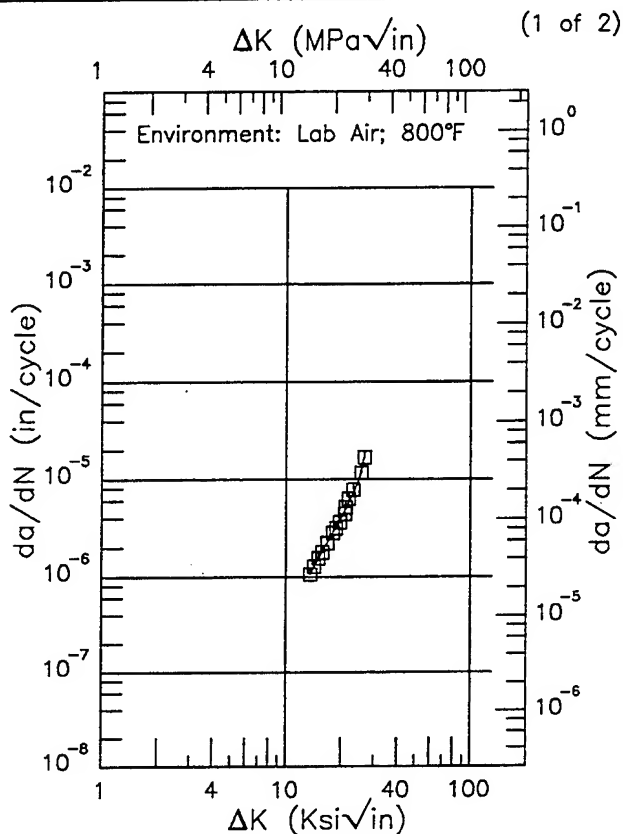


Figure 5.4.3.1.17 (Concluded)

E | IN100 |

Condition/Ht:  
Form: 1.6 in. Forging  
Specimen Type: CCP (max load specified)  
Orientation:  
Stress Ratio: -1  
Frequency: 0.2 Hz

Yield Strength: 169.1 ksi  
Ult. Strength: 236.5 ksi  
Specimen Thk: 0.298 - 0.299 in.  
Specimen Width: 0.995 - 1 in.  
Ref: PW002



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
13.48 (min)	1.06
16.	1.96
20.	3.97
25.	10.3
26.54 (max)	16.6

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
19.84 (min)	37.8
20.	38.5
25.	62.4
30.	91.0
35.	132.
40.	196.
42.98 (max)	253.

RMS  $\times$   
Error  
3.39

Life Prediction Ratio Summary  
□  
0. .5 .8 1.25 2.

RMS  $\times$   
Error  
4.70

Life Prediction Ratio Summary  
□  
0. .5 .8 1.25 2.

Figure 5.4.3.1.18

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CCP (max load specified)

Orientation:

Stress Ratio: -0.5

Frequency: 0.2 Hz

Yield Strength: 169.1 ksi

Ult. Strength: 236.5 ksi

Specimen Thk: 0.228 - 0.309 in.

Specimen Width: 0.988 - 1.038 in.

Ref: PW002

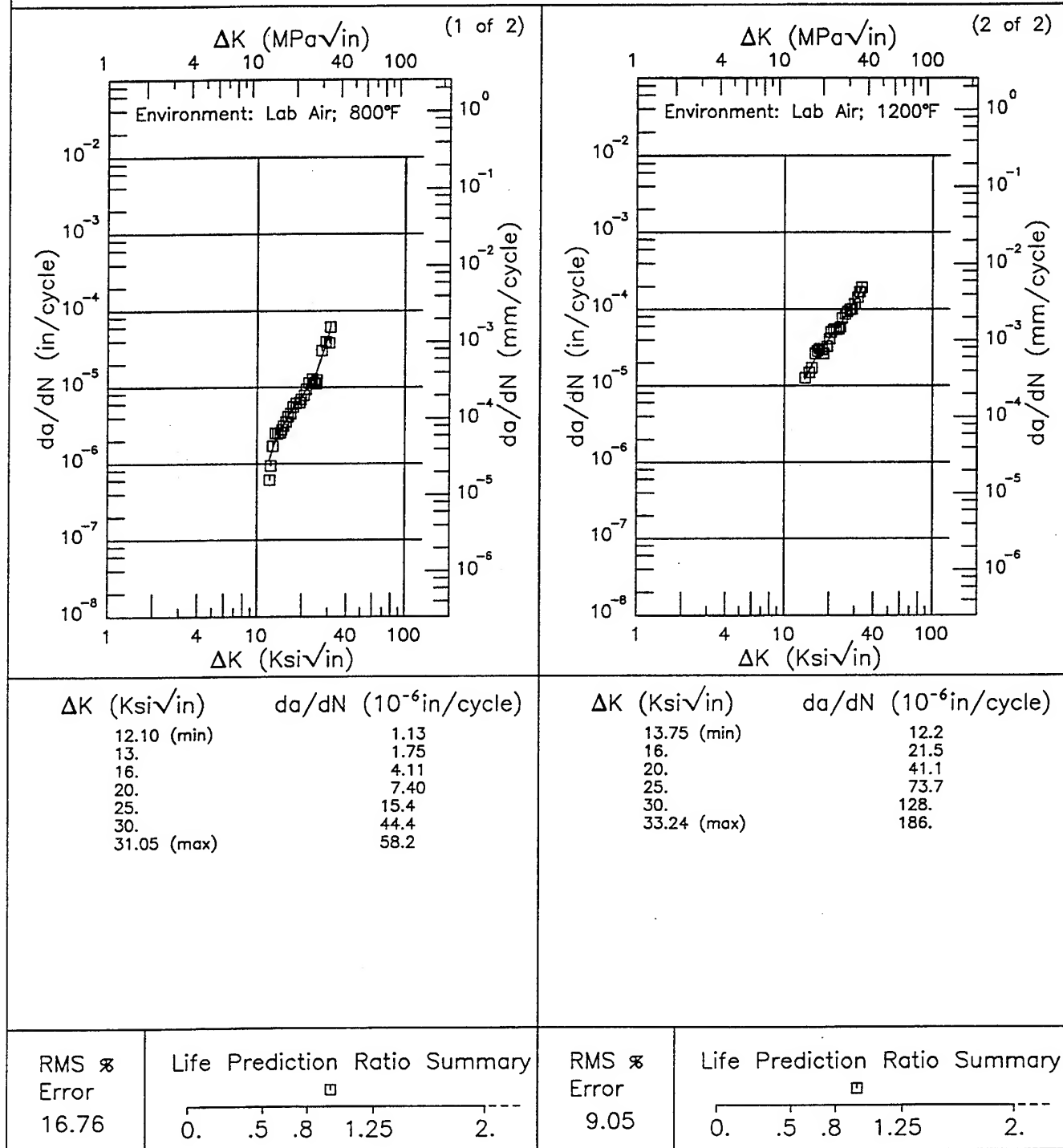


Figure 5.4.3.1.19



Form: 1.6 in. Forging

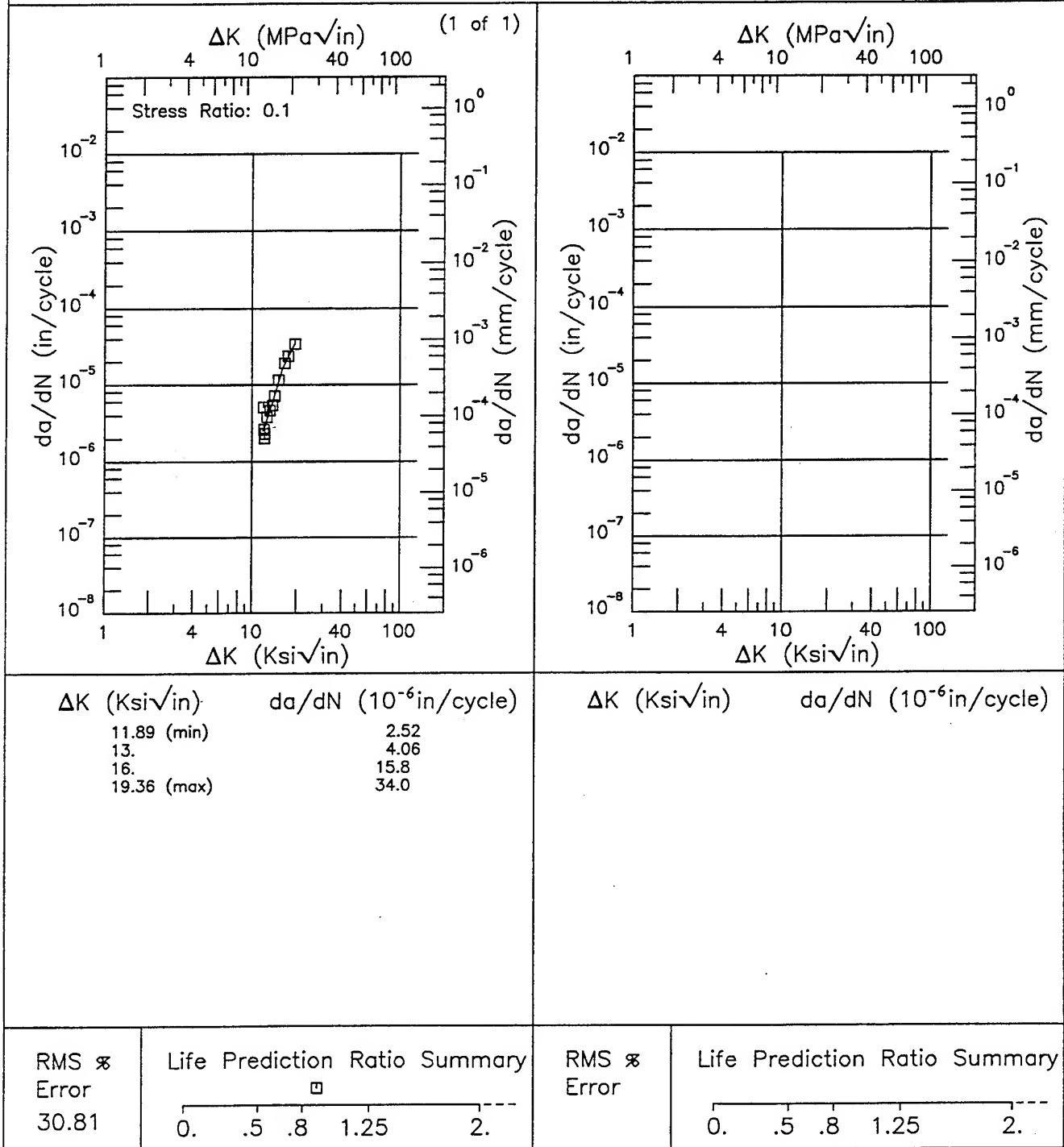
Orientation:

Environment: LAB AIR;1200°F

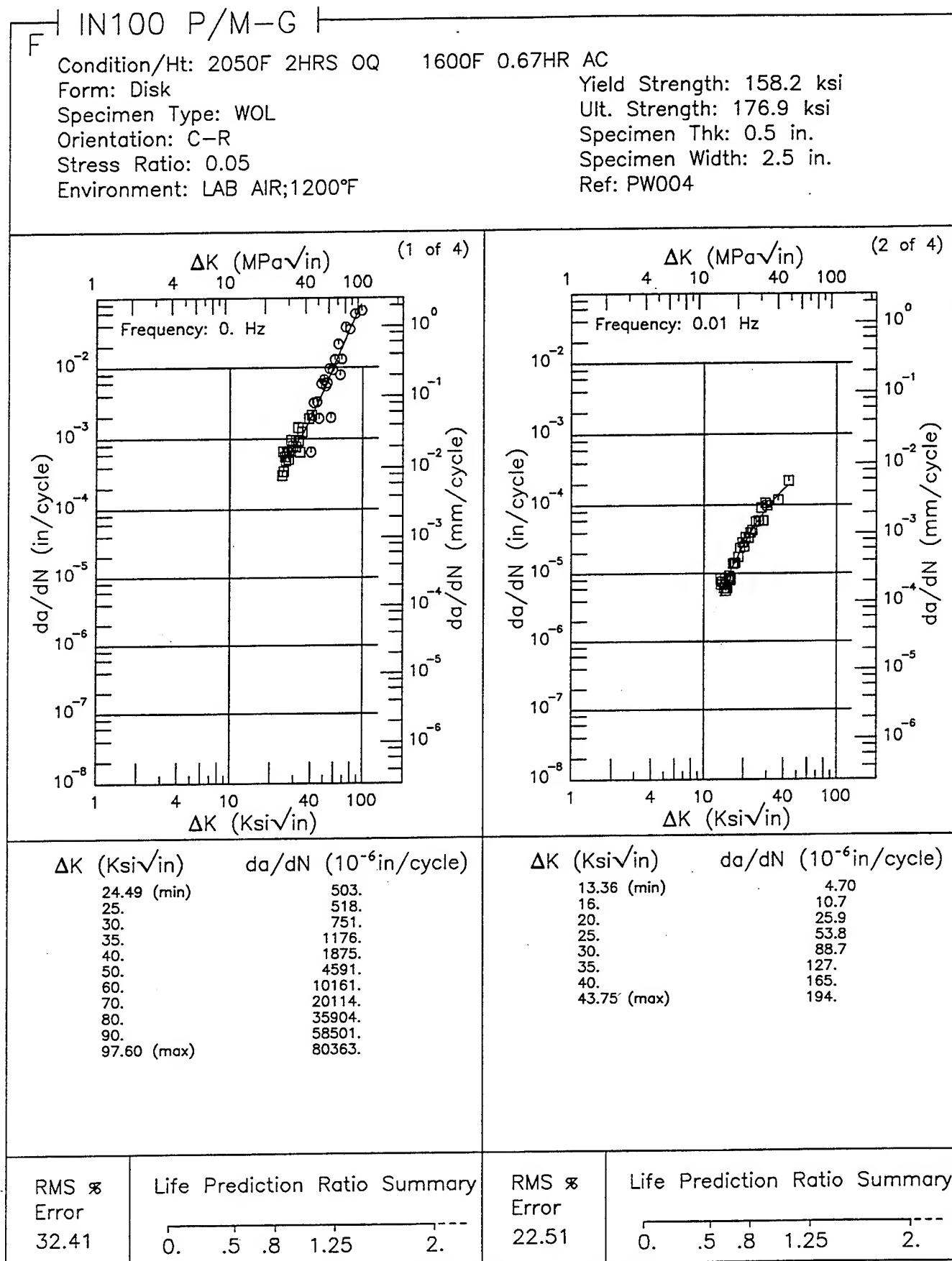
Ult. Strength: 236.5 ksi

Specimen Width: 0.722 in.

Ref: PW002



5-51



**Figure 5.5.3.1**

Condition/Ht: 2050F 2HRS OQ  
 Form: Disk  
 Specimen Type: WOL  
 Orientation: C-R  
 Stress Ratio: 0.05  
 Environment: LAB AIR;1200°F

1600F 0.67HR AC

Yield Strength: 158.2 ksi  
 Ult. Strength: 176.9 ksi  
 Specimen Thk: 0.5 in.  
 Specimen Width: 2.5 in.  
 Ref: PW004

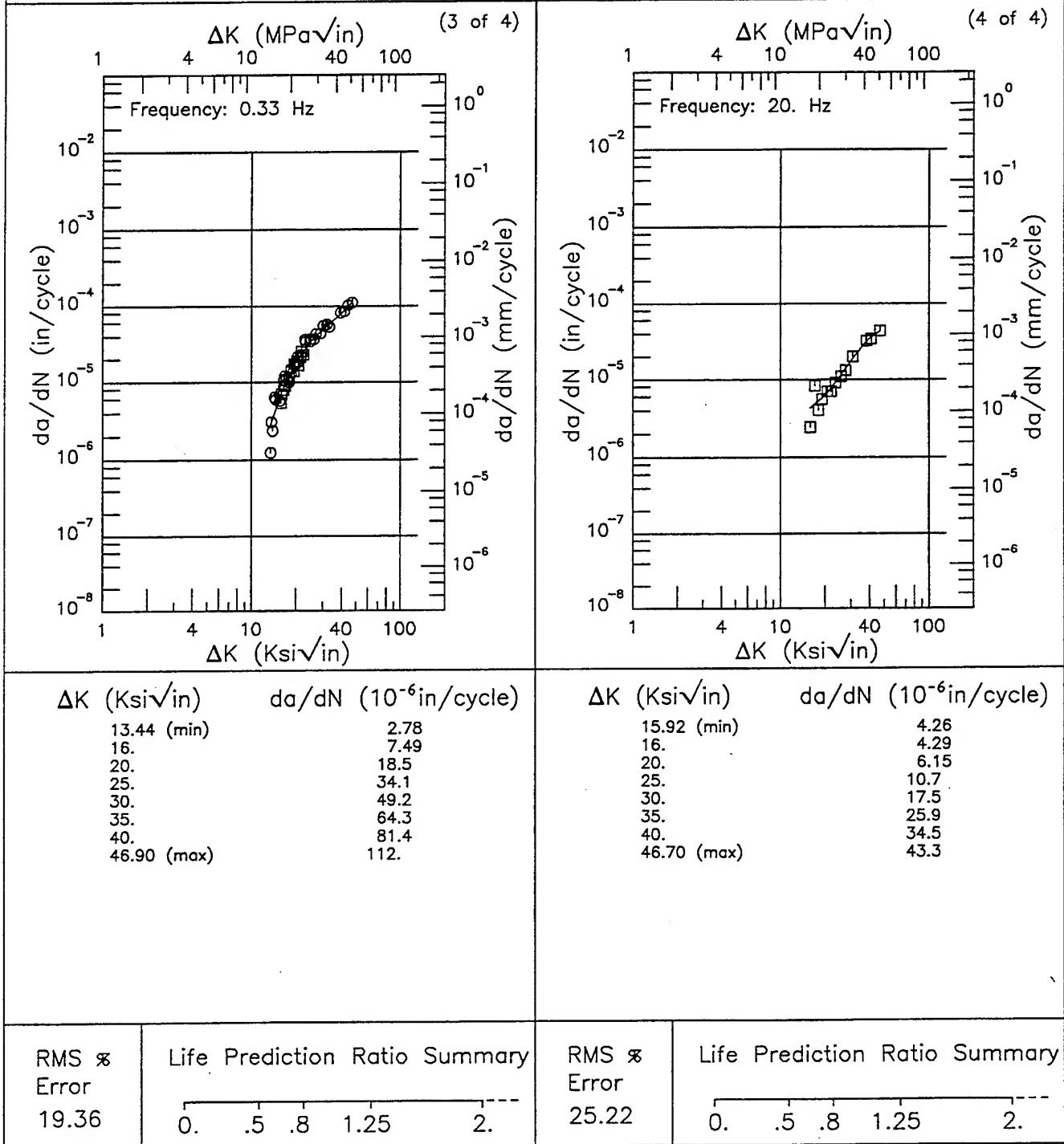
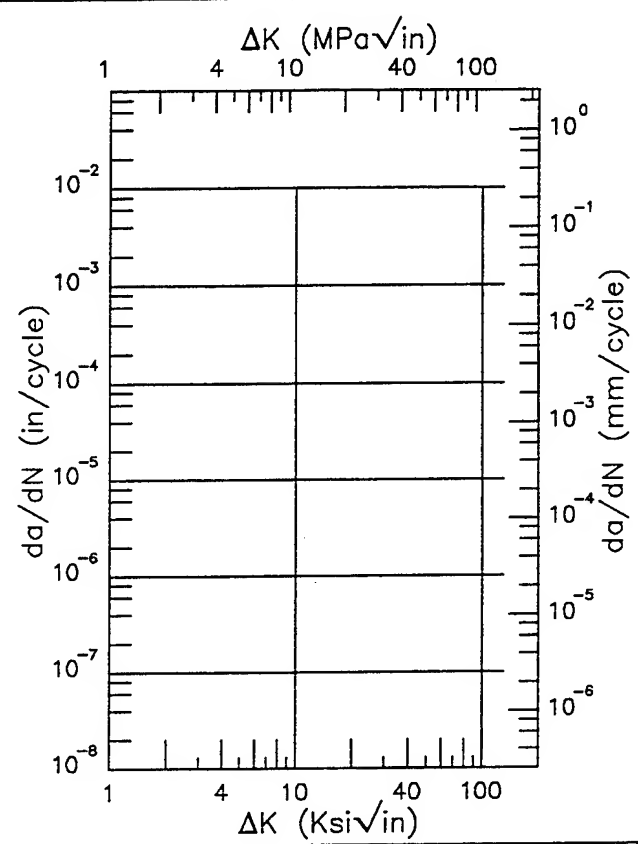
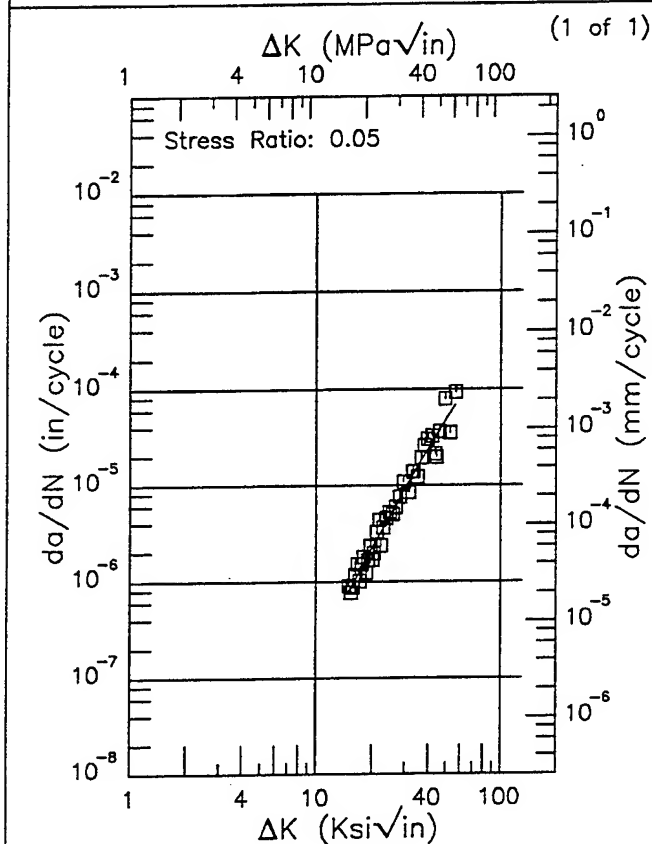


Figure 5.5.3.1 (Concluded)

# R INCOLOY 901

Condition/Ht:  
Form:  
Specimen Type: CT  
Orientation: C-R  
Frequency: 20 Hz  
Environment: LAB AIR;900°F

Yield Strength:  
Ult. Strength:  
Specimen Thk: 0.5 in.  
Specimen Width: 2.5 in.  
Ref: PW003



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
14.89 (min)	0.779
16.	1.00
20.	2.20
25.	4.87
30.	9.23
35.	15.6
40.	24.3
50.	48.7
56.30 (max)	68.7

$\Delta K$  (Ksi√in)  $da/dN$  ( $10^{-6}$  in/cycle)

RMS %  
Error  
24.06

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 5.6.3.1



**This page intentionally left blank**

# R INCONEL 600

Condition/Ht: 1585F .75HR AC  
 Form: 1 in. Plate  
 Specimen Type: CT  
 Orientation:  
 Frequency: 6.7 Hz  
 Environment: LAB AIR;1000°F

Yield Strength: 35 ksi  
 Ult. Strength: 94.3 ksi  
 Specimen Thk: 0.41 – 0.413 in.  
 Specimen Width: 2.002 – 2.004 in.  
 Ref: HD003

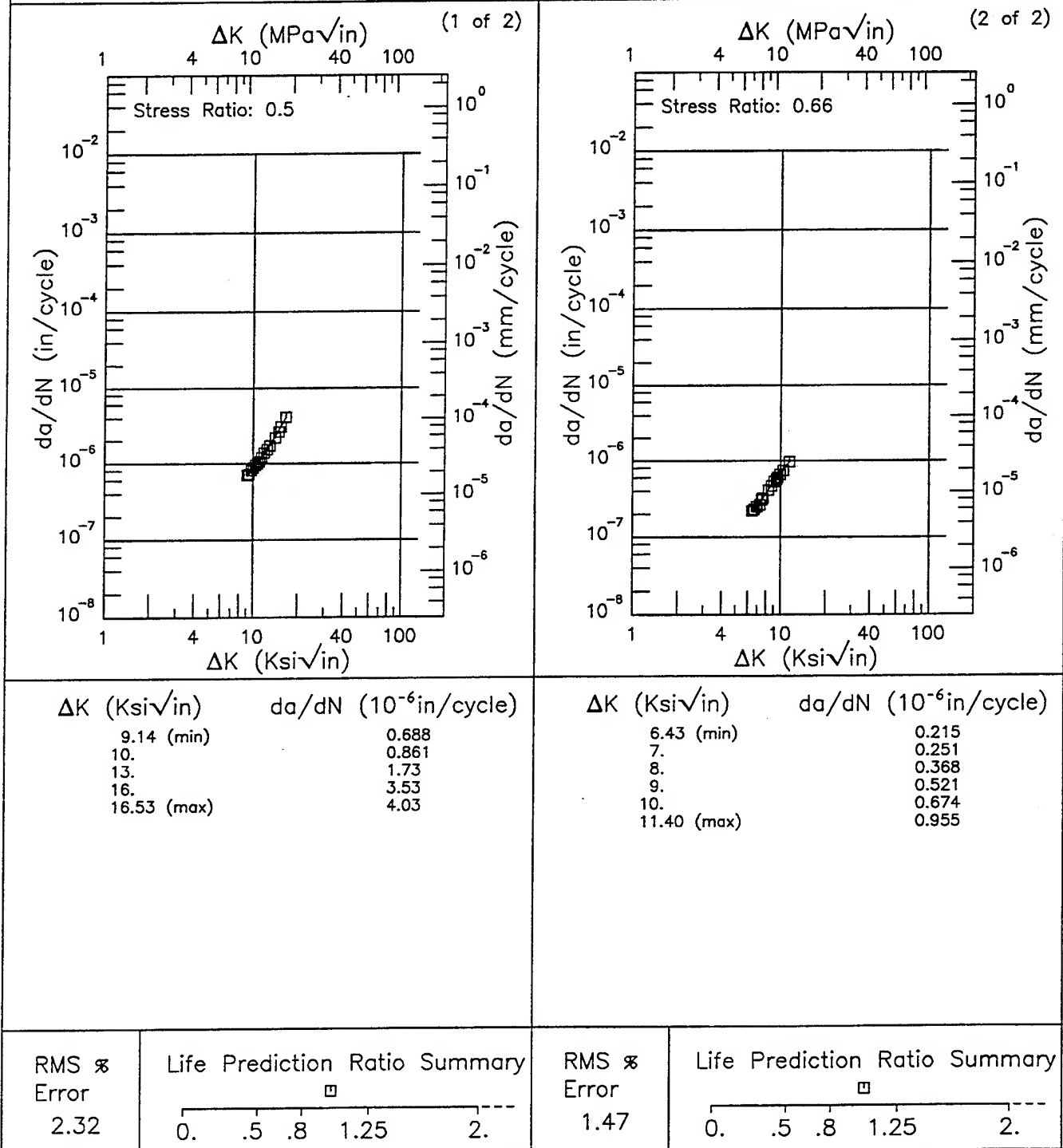


Figure 5.7.3.1.1

Condition/Ht: 1585F .75HR AC  
 Form: 1 in. Plate  
 Specimen Type: CT  
 Orientation:  
 Frequency: 6.7 Hz  
 Environment: LAB AIR;800°F

Yield Strength: 35 ksi  
 Ult. Strength: 94.3 ksi  
 Specimen Thk: 0.413 in.  
 Specimen Width: 2.002 in.  
 Ref: HD003

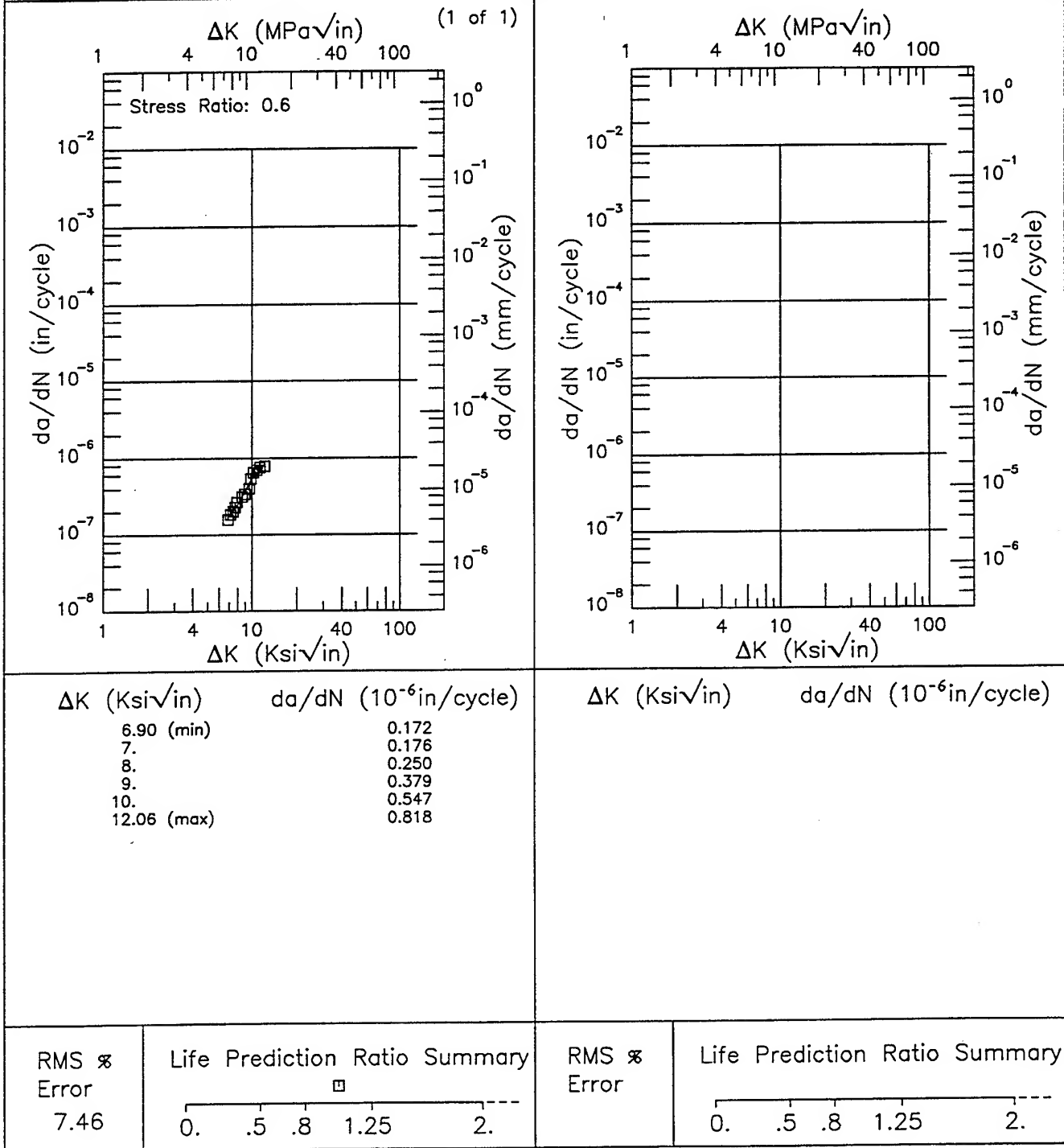


Figure 5.7.3.1.2

# E | INCONEL 600 |

Condition/Ht: 1585F .75HR AC  
 Form: 1 in. Plate  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 35 ksi  
 Ult. Strength: 94.3 ksi  
 Specimen Thk: 0.396 - 0.482 in.  
 Specimen Width: 1.997 - 2.005 in.  
 Ref: HD003

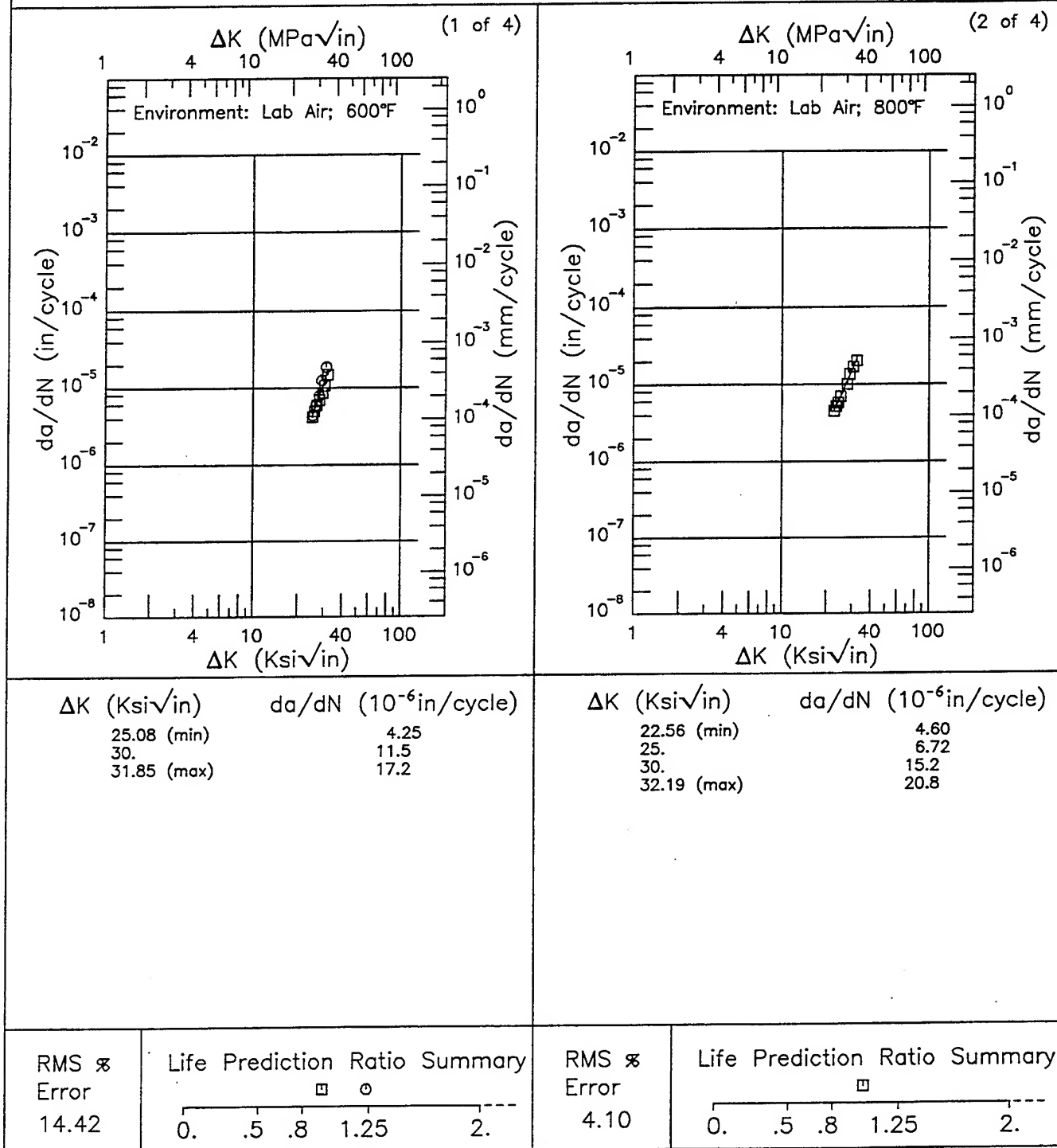


Figure 5.7.3.1.3

Condition/Ht: 1585F .75HR AC  
 Form: 1 in. Plate  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 35 ksi  
 Ult. Strength: 94.3 ksi  
 Specimen Thk: 0.396 - 0.482 in.  
 Specimen Width: 1.997 - 2.005 in.  
 Ref: HD003

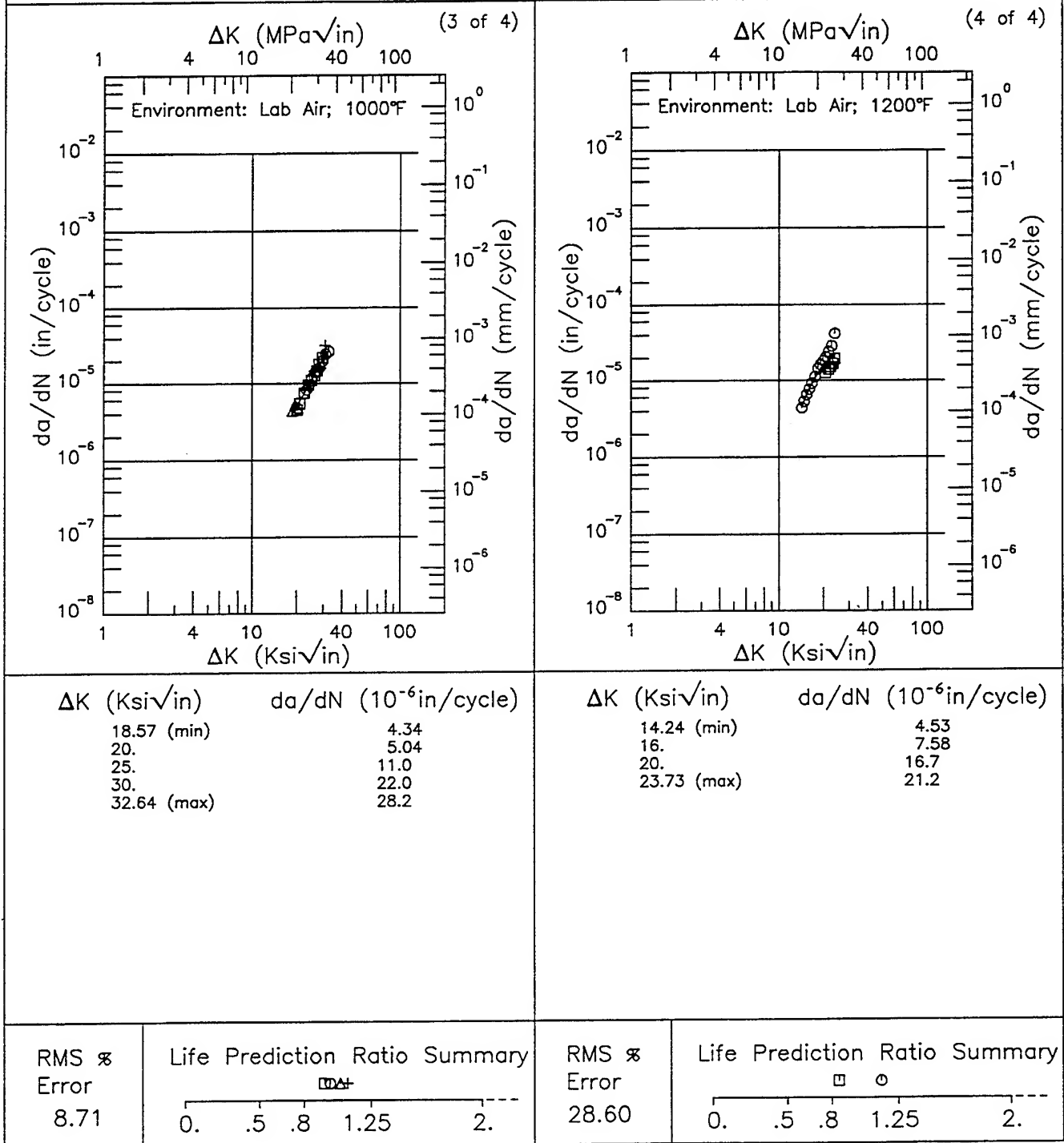
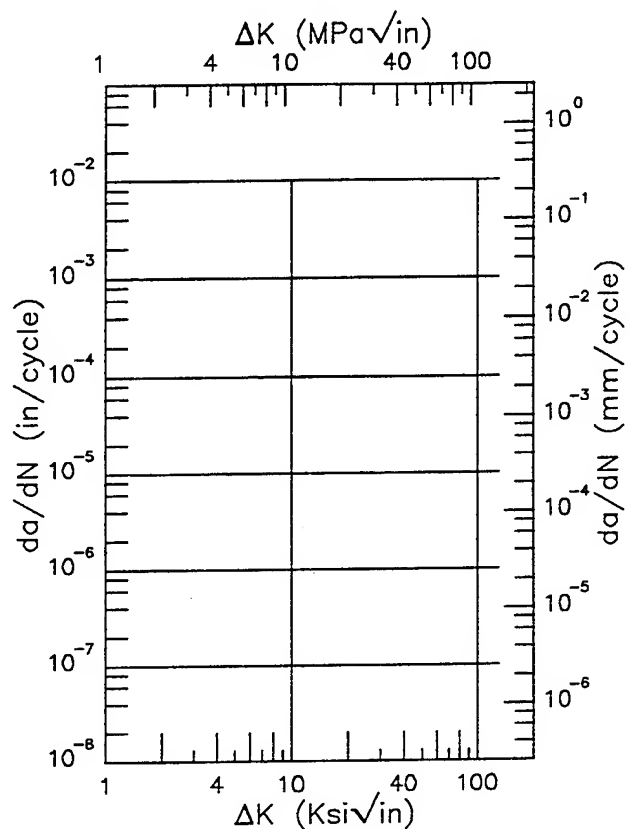
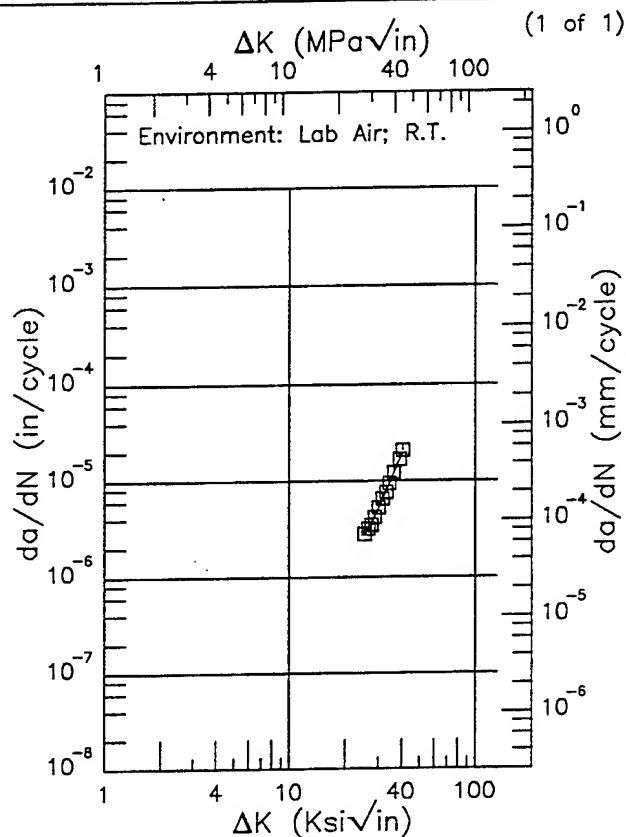


Figure 5.7.3.1.3 (Concluded)

E INCONEL 600

Condition/Ht: 1585F .75HR AC  
 Form: 1 in. Plate  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 5 Hz

Yield Strength: 35 ksi  
 Ult. Strength: 94.3 ksi  
 Specimen Thk: 0.39 in.  
 Specimen Width: 2 in.  
 Ref: HD003



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
25.33 (min)	2.73
30.	5.03
35.	10.3
40.	18.7
40.56 (max)	19.8

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )      da/dN (10<sup>-6</sup>in/cycle)

RMS %  
Error  
3.56

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 5.7.3.1.4

Condition/Ht: 1585F .75HR AC  
 Form: 1 in. Plate  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 6.7 Hz

Yield Strength: 35 ksi  
 Ult. Strength: 94.3 ksi  
 Specimen Thk: 0.412 - 0.414 in.  
 Specimen Width: 2.002 in.  
 Ref: HD003

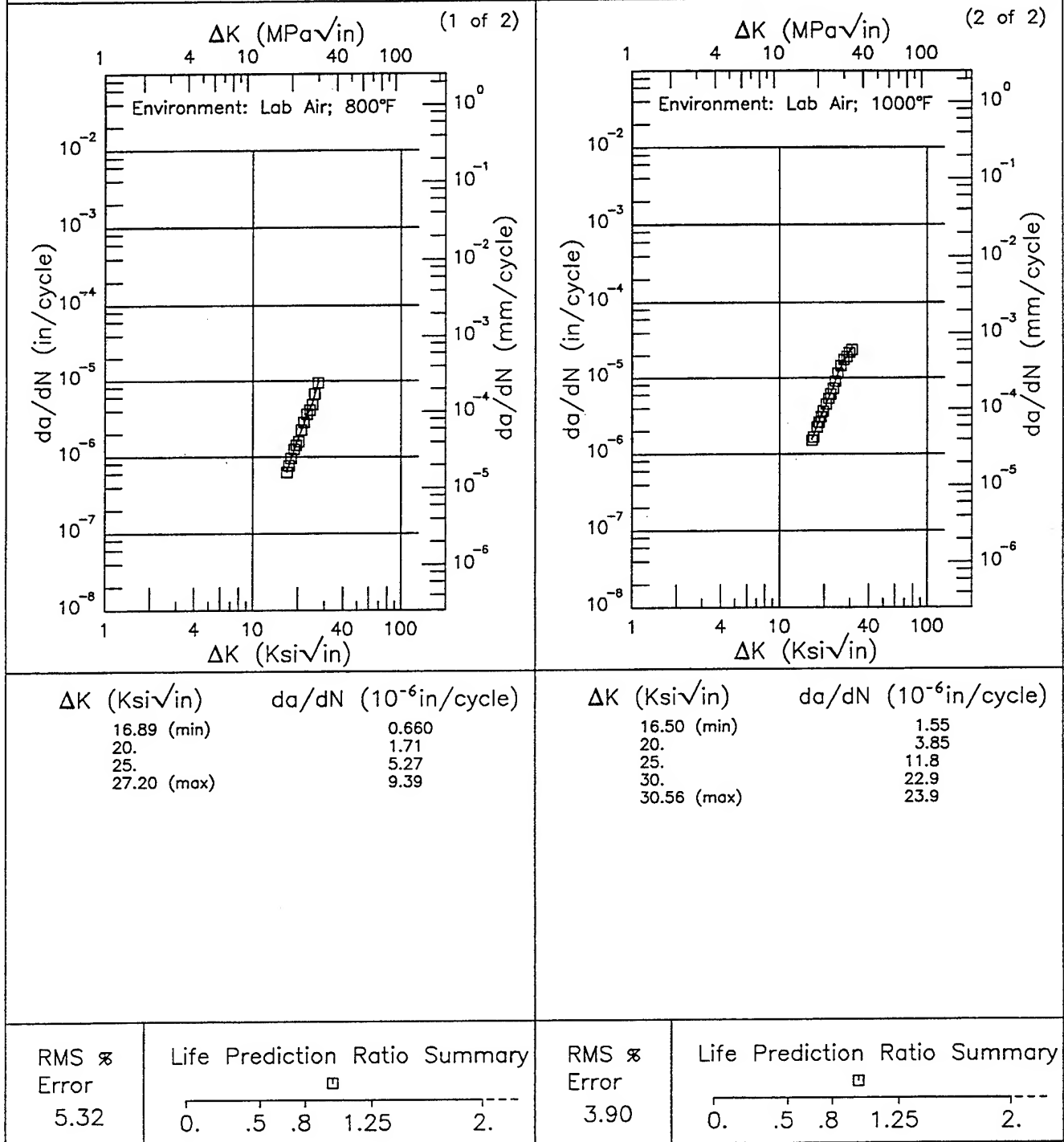


Figure 5.7.3.1.5

# INCONEL 600

E

Condition/Ht: 1585F .75HR AC  
 Form: 1 in. Plate  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.33  
 Frequency: 6.7 Hz

Yield Strength: 35 ksi  
 Ult. Strength: 94.3 ksi  
 Specimen Thk: 0.413 in.  
 Specimen Width: 2.002 - 2.003 in.  
 Ref: HD003

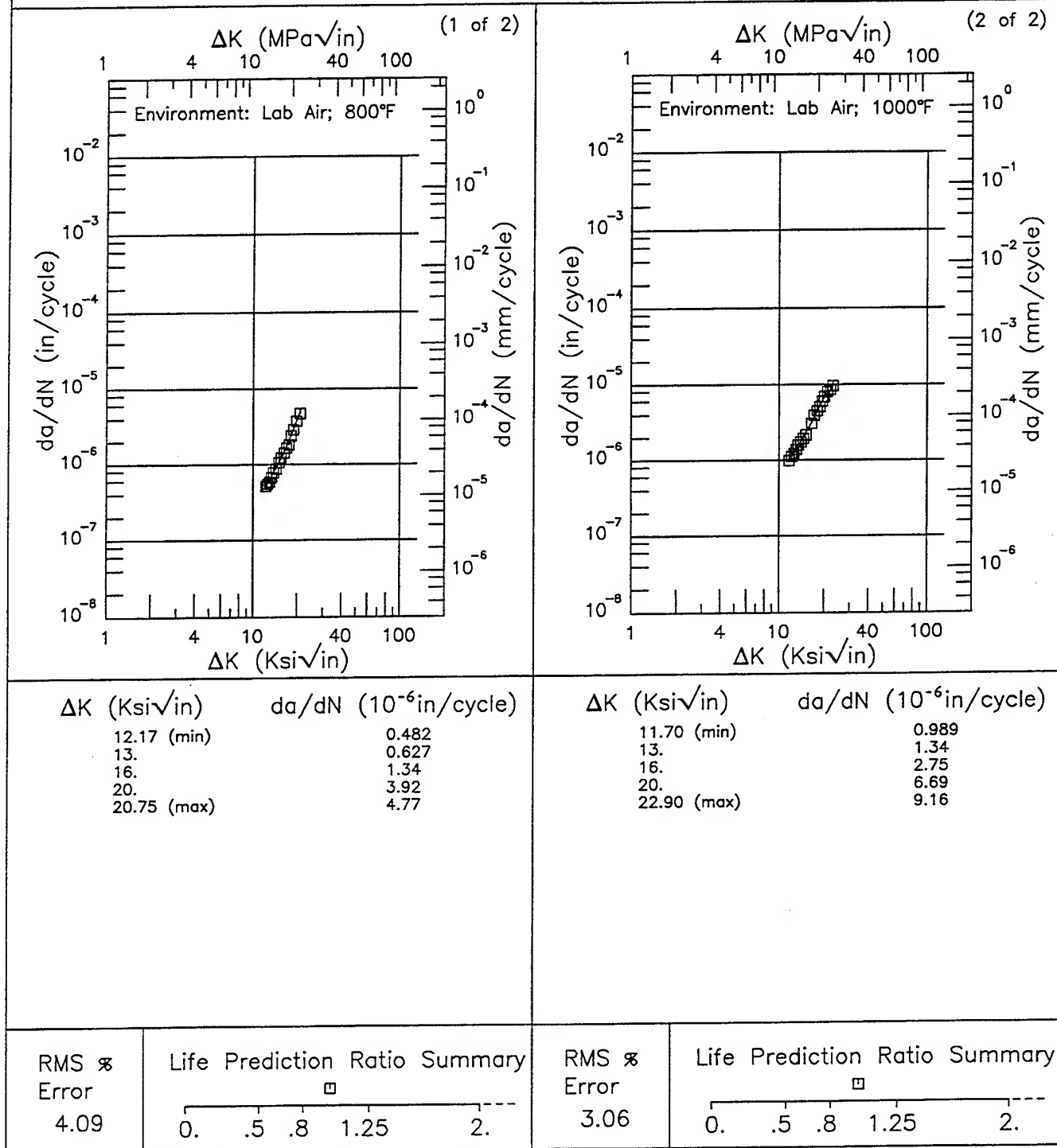


Figure 5.7.3.1.6



TABLE 5.8.1.2

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**INCONEL 625 AT ROOM TEMPERATURE**

ORIENTATION: Unspecified

ENVIRONMENT: Lab Air

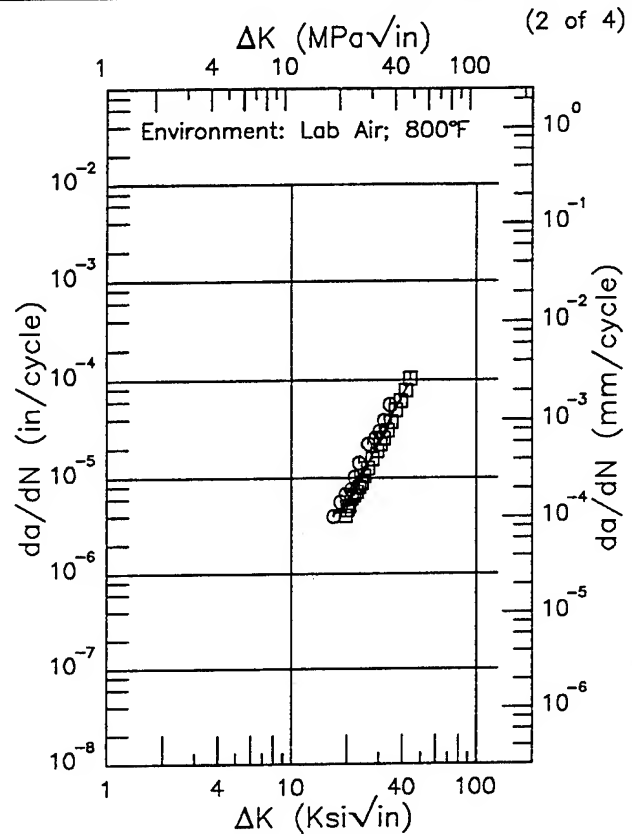
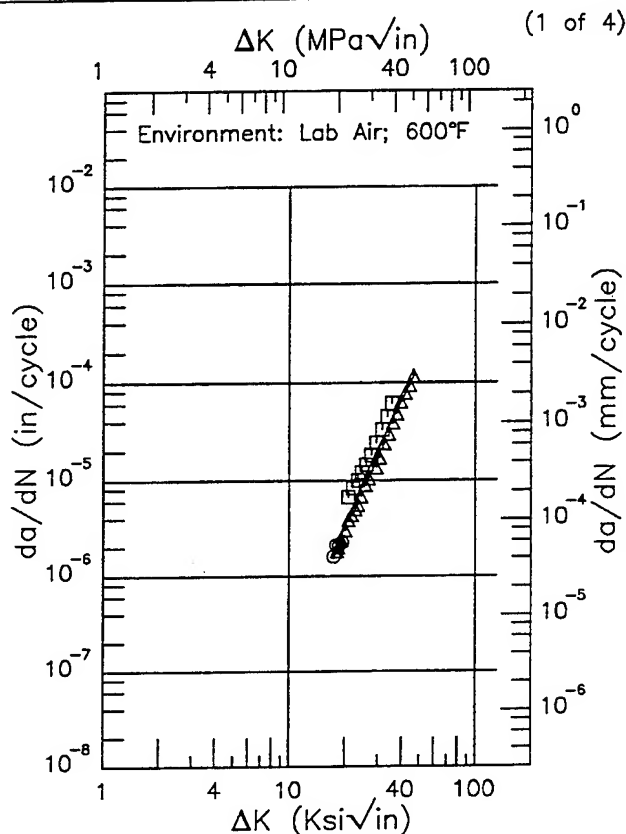
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-8}$ in/cycle)				
				$\Delta K$ Level (Ksk/in)				
				2.5	5.0	10.0	20.0	50.0
MA	PLATE	0.05	10					
							2.07	
								100.0

# INCONEL 625

E

Condition/Ht: MA  
Form: 1 in. Plate  
Specimen Type: CT  
Orientation:  
Stress Ratio: 0.05  
Frequency: 0.7 Hz

Yield Strength: 65.9 ksi  
Ult. Strength: 132.9 ksi  
Specimen Thk: 0.299 - 0.445 in.  
Specimen Width: 1.153 - 2.002 in.  
Ref: HD005



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
17.31 (min)	1.51
20.	3.33
25.	9.73
30.	21.2
35.	39.0
40.	65.0
46.44 (max)	115.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
16.88 (min)	4.04
20.	5.70
25.	11.7
30.	23.7
35.	43.2
40.	69.1
44.02 (max)	92.1

RMS %  
Error  
25.35

Life Prediction Ratio Summary

$\Delta$   $\square$

0. .5 .8 1.25 2.

RMS %  
Error  
22.59

Life Prediction Ratio Summary

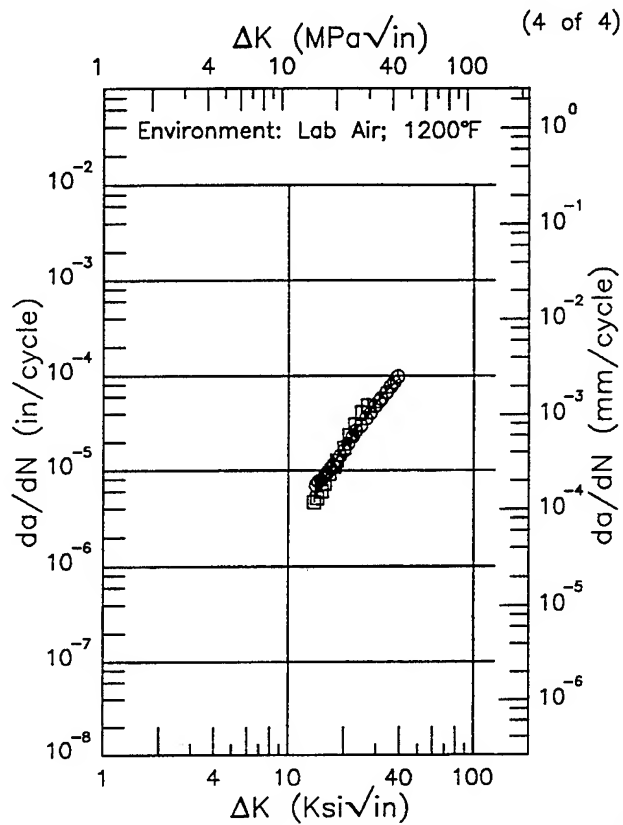
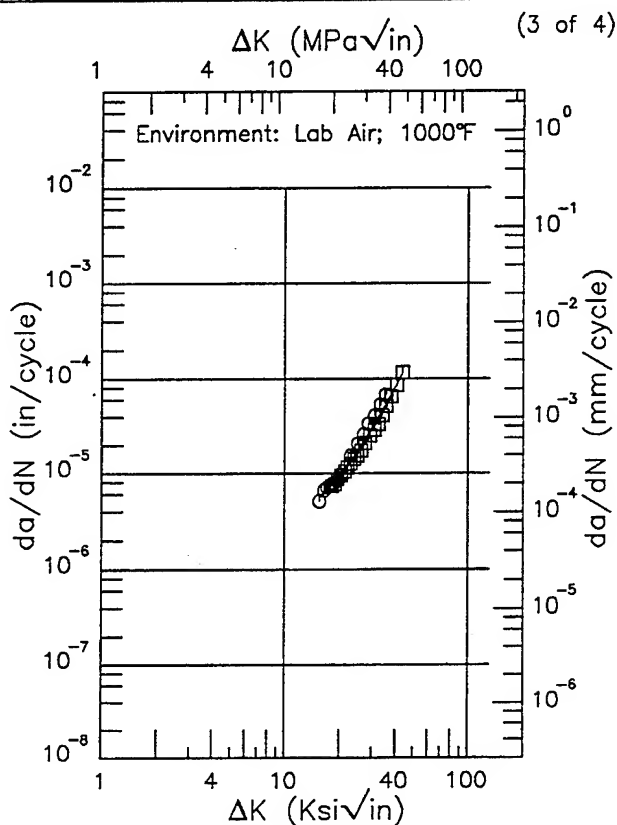
$\square$   $\circ$

0. .5 .8 1.25 2.

Figure 5.8.3.1.1

Condition/Ht: MA  
Form: 1 in. Plate  
Specimen Type: CT  
Orientation:  
Stress Ratio: 0.05  
Frequency: 0.7 Hz

Yield Strength: 65.9 ksi  
Ult. Strength: 132.9 ksi  
Specimen Thk: 0.299 - 0.445 in.  
Specimen Width: 1.153 - 2.002 in.  
Ref: HD005



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
15.46 (min)	5.62
16.	5.92
20.	9.27
25.	17.0
30.	30.4
35.	51.6
40.	82.9
43.39 (max)	111.

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
13.75 (min)	5.39
16.	8.63
20.	17.1
25.	32.7
30.	52.5
35.	74.2
38.90 (max)	91.0

RMS %  
Error  
11.99

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
Error  
10.79

Life Prediction Ratio Summary

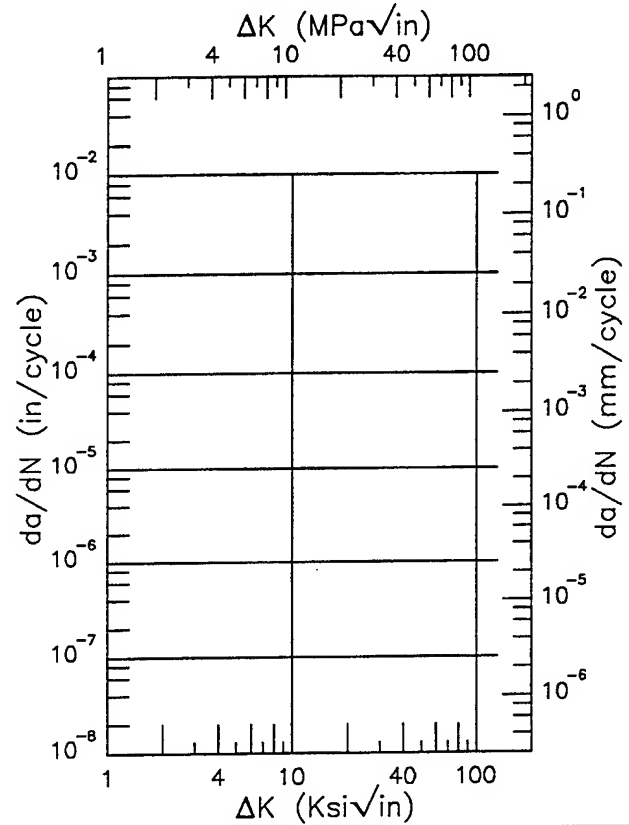
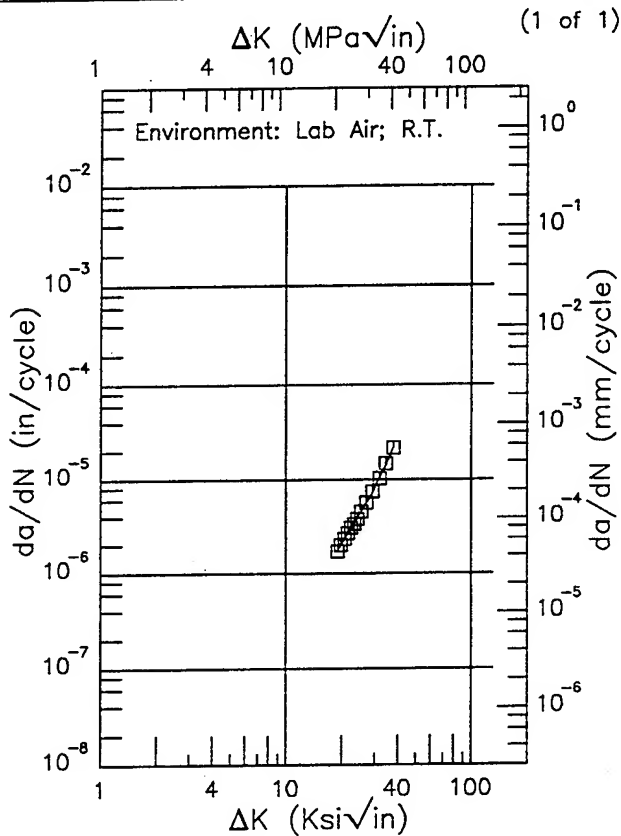
0. .5 .8 1.25 2.

Figure 5.8.3.1.1 (Concluded)

# INCONEL 625

Condition/Ht: MA  
Form: 1 in. Plate  
Specimen Type: CT  
Orientation:  
Stress Ratio: 0.05  
Frequency: 10 Hz

Yield Strength: 65.9 ksi  
Ult. Strength: 132.9 ksi  
Specimen Thk: 0.295 in.  
Specimen Width: 1.153 in.  
Ref: HD005



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
18.93 (min)	1.71
20.	2.07
25.	4.35
30.	8.25
35.	15.4
37.87 (max)	22.2

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )      da/dN (10<sup>-6</sup>in/cycle)

RMS  $\times$   
Error  
1.70

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS  $\times$   
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 5.8.3.1.2

Condition/Ht: MA  
Form: 1 in. Plate  
Specimen Type: CT  
Orientation:  
Stress Ratio: 0.05  
Frequency: 10 Hz

Yield Strength: 65.9 ksi  
Ult. Strength: 132.9 ksi  
Specimen Thk: 0.443 in.  
Specimen Width: 2.002 in.  
Ref: HD005

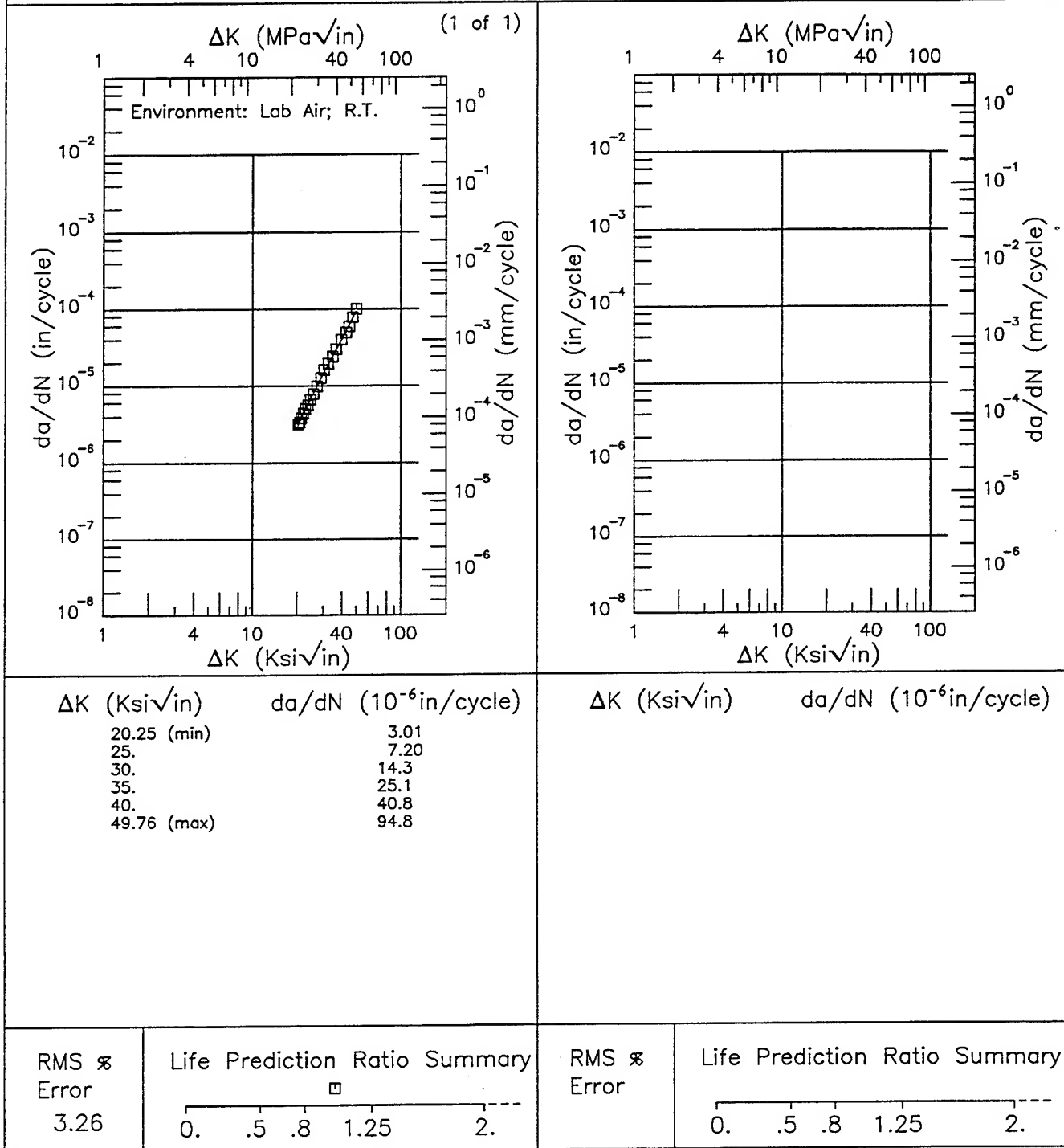


Figure 5.8.3.1.3

**TABLE 5.9.1.1**  
**MEAN PLANE STRAIN FRACTURE TOUGHNESS**  
**FOR NICKEL BASE ALLOY INCONEL 718 AT ROOM TEMPERATURE**

Product Form	Condition/Heat Treatment	$K_{Ic}$ (ksi $\sqrt{in}$ )									
		Specimen Orientation									
		L-T			T-L			S-L			
		Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	
Forging	STA	118.5	0.7	2	107.9	14.	2	---	---	---	---

TABLE 5.9.1.2.1

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**INCONEL 718 AT ROOM TEMPERATURE**

ORIENTATION: L-T		ENVIRONMENT: Distilled Water					
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-8}$ in/cycle)			
				$\Delta K$ Level (Kksi/in)			
				2.5	5.0	10.0	50.0
STA	FORGING	0.1	1			2	73.61
							100.0

TABLE 5.9.1.2.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**INCONEL 718 AT ROOM TEMPERATURE**

ORIENTATION: L-T		ENVIRONMENT: L.H.A.							
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/in)					
				2.5	5.0	10.0	20.0	50.0	100.0
1325F 8HRS FC TO 1150F	FORGING	0.08	6				1.13	19.35	
		0.5	6				2.17	33.96	
ST 1850F 1360 F 9HRS F/C 1175F	FORGED BAR	0.08	6					10.16	
		0.5	6				1.16	33.41	



TABLE 5.9.1.2.3

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
INCONEL 718 AT ROOM TEMPERATURE**

**ORIENTATION: L-T****ENVIRONMENT: Lab Air**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	$FCGR (10^{-6} \text{ in/cycle})$					
				$\Delta K \text{ Level } (K_{SI}/\text{in})$					
				2.5	5.0	10.0	20.0	50.0	100.0
1750F AC 1325F	PLATE	0.05	8.33				1.28	30.57	
1950F AC 1325F	PLATE	0.05	8.33				1.05		
ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HOUR TO 1150F, 1150F 8HR, AC	PLATE	-0.2	10				1.14		
		0.02	4				0.92	16.4	
		0.02	20				1.75		
		0.5	10				2.97		
STA	FORGING	0.1	15-20				2.45	57.53	
		0.4	20				3.42		
		0.8	20-30			0.47			
UNSPECIFIED	UNSPECIFIED	0.1	10			0.13	2.46	56.78	

TABLE 5.9.1.2.4

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
INCONEL 718 AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: S.T.W.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-8}$ in/cycle)				
				$\Delta K$ Level (Ksi/in)				
				2.5	5.0	10.0	20.0	50.0
ST 1850F 1360 F 9HRS F/C 1175F	FORGED BAR	0.08	1					100.0
								11.87

TABLE 5.9.1.2.5

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**INCONEL 718 AT ROOM TEMPERATURE**

ORIENTATION: L-T		ENVIRONMENT: Vacuum							
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/in)					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HOUR TO 1150F, 1150F 8HR, AC	PLATE	0.1	10				1.02	25.74	

TABLE 5.9.1.2.6

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**INCONEL 718 AT ROOM TEMPERATURE**

ORIENTATION: T-L		ENVIRONMENT: Distilled Water									
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-8}$ in/cycle)							
				AK Level (Kksi/in)							
				2.5	5.0	10.0	20.0	50.0	100.0		
STA	FORGING	0.1	1				2.3				
		0.8	1			0.83					

TABLE 5.9.1.2.7

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**INCONEL 718 AT ROOM TEMPERATURE**

ORIENTATION: T-L				ENVIRONMENT: L.H.A.							
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)							
				$\Delta K$ Level (Ksi/in)							
				2.5	5.0	10.0	20.0	50.0	100.0		
1325F 8HRS FC TO 1150F	FORGING	0.08	6							30.86	
ST 1850F 1360 F 9HRS F/C 1175F	FORGED BAR	0.08	6							16.09	

TABLE 5.9.1.2.8

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**INCONEL 718 AT ROOM TEMPERATURE**

ORIENTATION: T-L				ENVIRONMENT: Lab Air						
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-8}$ in/cycle)						
				$\Delta K$ Level (Ksi/in)						
				2.5	5.0	10.0	20.0	50.0	100.0	
1750F 1HR AC 1325F	FORGED BAR	0.05	8.33-10				3.08	116.49		
STA	FORGING	-1	5				0.69	29.84		
		0.1	15-20				2.19	83.07		
		0.4	20				3.16			
		0.8	20-30			0.47				



TABLE 5.9.1.2.9

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**INCONEL 718 AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: S.C.S.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Kak/in)					
				2.5	5.0	10.0	20.0	50.0	100.0
ST 1850F 1360 F 9HRS F/C 1175F	FORGED BAR	0.08	1					10.23	

TABLE 5.9.1.2.10

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**INCONEL 718 AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: S.T.W.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				AK Level (Ksi/in)					
				2.5	5.0	10.0	20.0	50.0	100.0
ST 1850F 1360 F 9HRS F/C 1175F	FORGED BAR	0.08	1					8.23	



TABLE 5.9.1.2.11

**1 of 1**

# FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR $\Delta K$ INCONEL 718 AT ROOM TEMPERATURE

**ORIENTATION: S-L**

## ENVIRONMENT: L.H.A.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)							
				$\Delta K$ Level (Kksi/in)							
				2.5	5.0	10.0	20.0	50.0	100.0		
ST 1850F 1360 F 9HRS F/C 1175F	FORGED BAR	0.08	6							26.94	

TABLE 5.9.1.2.12

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**INCONEL 718 AT ROOM TEMPERATURE**

ORIENTATION: C-R		ENVIRONMENT: Lab Air									
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)							
				$\Delta K$ Level (K $\sqrt{\text{in}}$ )							
				2.5	5.0	10.0	20.0	50.0	100.0		
1750F AC 1325F	FORGED BAR	0.05	10								
1760F 1HR WQ 1325F 8HRS	DISK	0.	0.33				2.56	43.72			
							3.39				

TABLE 5.9.1.2.13

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**INCONEL 718 AT ROOM TEMPERATURE**

ORIENTATION: Unspecified				ENVIRONMENT: Lab Air						
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)						
				$\Delta K$ Level (Kksi/in)						
				2.5	5.0	10.0	20.0	50.0	100.0	
1750F 1HR AC 1325F	PLATE	0.05	10				1.65			
1750F AC 1325F	SHEET	0.05	5				1.95			
	FORGING	0.05	10				1.93	40.69		

TABLE 5.9.2.1

INCONEL 718 K <sub>1c</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>1c</sub> TYS)* (in.)	K <sub>1c</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>1c</sub> (Ksi√in.)	K <sub>1c</sub> MEAN	STAN DEV		
1325F 8 HR FC TO 1150F HOLD 18 HR	Forging	3.00	R.T.	T-L	160.0	4.022	1.120	CT	1.987	0.53	74.00	---	---	1973	88187
1325F 9 HR FC TO 1150F AT 100F/HR HOLD AT 1150F 8 HR AC	Forging	3.30	R.T.	T-L	151.0	2.002	0.746	CT	1.049	0.68	78.80	---	---	1973	88187
1325F 9 HR FC TO 1150F AT 100F/HR HOLD AT 1150F 8 HR AC	Forging	3.30	R.T.	S-L	143.0	2.002	0.749	CT	1.060	0.53	65.50	---	---	1973	88187
ST-CW-A	Round Bar	1.39	0	L-R	210.0	1.202	0.600	NB	0.573	0.15	51.80	52.6	1.1	1991	NH006
		1.39			210.0	1.202	0.599	NB	0.595	0.15	52.10			1991	NH006
		1.39			210.0	1.202	0.600	NB	0.597	0.16	53.90			1991	NH006
STA	Forging	3.00	-65	L-T	168.6	3.006	1.498	CT	1.576	1.33	122.80	102.8	28.4	1987	DA007
STA	Forging	1.50	-65	L-T	181.1	3.014	1.500	CT	1.625	0.52	82.70			1987	DA006
STA	Forging	3.00	-65	T-L	172.4	3.006	1.495	CT	1.656	1.03	110.90	---	---	1987	DA007
	Forging	3.00	R.T.	L-T	161.2	3.007	1.499	CT	1.567	1.34	118.00	118.5	0.7	1987	DA007
		3.00	R.T.	L-T	161.2	3.008	1.516	CT	1.531	1.36	119.00			1987	DA007
STA	Forging	3.00	R.T.	T-L	155.4	3.005	1.497	CT	1.601	1.44	117.80	107.9	14.0	1987	DA007
		3.00	R.T.	T-L	155.4	3.006	1.500	CT	1.593	0.99	98.00			1987	DA007
	STA	Round Bar	1.39	0	L-R	179.0	1.199	0.599	NB	0.737	0.47	77.30	81.1	3.4	1991
1.39	179.0		1.201			0.600	NB	0.628	0.49	79.40	1991	NH006			
1.39	179.0		1.199			0.599	NB	0.615	0.54	82.90	1991	NH006			
1.39	179.0		1.200			0.600	NB	0.619	0.56	84.90	1991	NH006			

TABLE 5.9.2.2

1 of 4

INCONEL 718

INCONEL 718 K <sub>G</sub>																							
CONDITION AT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>			K <sub>G</sub>			DATE	REFER				
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>y</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi) √(in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>G</sub> (Ksi) √(in.)	K <sub>G</sub> MEAN	STAN DEV						
BUCKLING OF CRACK EDGES NOT RESTRAINED																							
Cold Rolled 30 Percent and Aged	Sheet	0.03	-423	L-T	269.0	4.010	0.027	1.270	1.450	---	116.00	174.77	175.8	5.7	190.67	191.1	7.5	1964	60578				
		0.03			269.0	4.010	0.027	1.240	1.370	---	117.00	173.64			185.14			1964	60578				
		0.03			269.0	4.010	0.027	1.250	1.400	---	120.00	178.99			192.64			1964	60578				
		0.03			269.0	4.010	0.027	1.270	1.400	---	119.00	179.29			191.03			1964	60578				
		0.03			269.0	4.020	0.027	1.750	2.050	---	92.50	174.19			198.97			1964	60578				
		0.03			269.0	4.000	0.028	1.310	1.340	---	116.00	178.34			180.98			1964	60578				
		0.03			269.0	4.000	0.028	1.280	1.420	---	117.00	177.22			189.70			1964	60578				
		0.03			269.0	4.000	0.028	1.370	1.480	---	112.00	177.30			186.79			1964	60578				
		0.03			269.0	4.000	0.028	1.740	2.000	---	90.50	169.90			190.76			1964	60578				
		0.03			269.0	4.010	0.028	1.240	1.500	---	119.00	176.61			200.22			1964	60578				
		0.03			269.0	4.010	0.028	1.740	2.000	---	87.50	164.15			184.25			1964	60578				
		0.03			269.0	4.010	0.028	0.750	0.890	---	168.00	186.38			204.90*			1964	60578				
		0.03			269.0	4.010	0.028	1.250	1.400	---	118.00	176.01			189.43			1964	60578				
		0.03			269.0	4.010	0.028	0.740	0.950	---	169.00	186.13			213.90*			1964	60578				
		0.03			269.0	4.010	0.028	1.770	2.050	---	91.50	173.97			197.02			1964	60578				
		0.03			269.0	4.010	0.028	0.750	1.020	---	158.00	175.29			208.37			1964	60578				
		0.03			269.0	4.010	0.028	1.730	1.920	---	89.00	166.22			180.87			1964	60578				

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.

TABLE 5.9.2.2 (CONTINUED)

INCONEL 718 K <sub>C</sub>																											
CONDITIONS AT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>			K <sub>C</sub>			DATE	REFER								
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>i</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi) √(in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi) √(in.)	K <sub>C</sub> MEAN	STAN DEV										
BUCKLING OF CRACK EDGES NOT RESTRAINED																											
Cold Rolled 30 Percent and Aged	Sheet	0.03	-320	L-T	259.0	4.000	0.027	1.310	1.620	---	123.00	189.10	180.4			8.8			218.77	200.6			13.8			1964	60578
					259.0	4.010	0.027	1.250	1.400	---	126.00	187.94							202.27							1964	60578
					259.0	3.980	0.028	1.330	1.560	---	119.00	184.90							205.22							1964	60578
					259.0	4.000	0.028	0.730	0.930	---	169.00	184.78							211.35*							1964	60578
					259.0	4.000	0.028	1.270	1.650	---	121.00	182.37							218.16							1964	60578
					259.0	4.000	0.028	0.730	0.830	---	171.00	186.97*							200.60*							1964	60578
					259.0	4.000	0.028	1.290	1.650	---	118.00	179.63							212.75							1964	60578
					259.0	4.010	0.028	1.730	1.920	---	92.00	171.83							186.97							1964	60578
					259.0	4.010	0.028	1.300	1.750	---	125.00	191.16							235.55*							1964	60578
					259.0	4.010	0.028	1.250	1.450	---	119.00	177.50							195.61							1964	60578
					259.0	4.010	0.028	1.730	1.790	---	89.10	166.41							170.92							1964	60578
					259.0	4.010	0.028	1.720	2.000	---	90.30	167.90							190.15							1964	60578
					259.0	4.010	0.028	1.730	2.090	---	91.90	171.64							201.46							1964	60578
					259.0	4.010	0.028	0.740	0.950	---	177.00	194.94*							224.02*							1964	60578
					259.0	4.010	0.028	0.730	0.850	---	170.00	185.85*							202.06*							1964	60578
					259.0	4.010	0.028	1.230	1.400	---	127.00	187.53							203.87							1964	60578
					259.0	4.010	0.028	1.250	1.450	---	128.00	192.42							212.04							1964	60578
					259.0	4.010	0.028	1.720	1.950	---	91.90	170.88							189.27							1964	60578

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.

TABLE 5.9.2.2 (CONTINUED)

3 of 4

INCONEL 718

INCONEL 718 K <sub>C</sub>																			
CONDITION AT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>			K <sub>C</sub>		DATE	REFER	
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>0</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>0</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi) √(in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi) √(in.)	K <sub>C</sub> MEAN			STAN DEV
BUCKLING OF CRACK EDGES NOT RESTRAINED																			
Cold Rolled 30 Percent and Aged	Sheet	0.03	R.T.	L-T	218.0	4.020	0.026	1.310	1.700	--	114.00	175.14	161.4	8.6	209.94*	178.5	3.6	1964	60578
		0.03			218.0	4.010	0.027	1.280	1.500	--	118.00	178.68			198.54*			1964	60578
		0.03			218.0	4.000	0.028	1.730	1.980	--	83.00	155.12			173.40			1964	60578
		0.03			218.0	4.000	0.028	1.250	1.450	--	111.00	165.62			182.54			1964	60578
		0.03			218.0	4.000	0.028	1.250	1.550	--	112.00	167.12			192.94*			1964	60578
		0.03			218.0	4.000	0.028	1.720	2.100	--	81.80	152.20			180.32			1964	60578
		0.03			218.0	4.000	0.028	0.730	1.050	--	138.00	150.89			185.16*			1964	60578
		0.03			218.0	4.000	0.028	1.230	1.480	--	116.00	171.34			193.46*			1964	60578
		0.03			218.0	4.010	0.028	1.720	2.150	--	85.50	158.98			192.56*			1964	60578
		0.03			218.0	4.010	0.028	0.740	0.880	--	138.00	151.99			167.24*			1964	60578
		0.03			218.0	4.010	0.028	0.720	0.940	--	145.00	157.34*			182.41*			1964	60578
		0.03			218.0	4.010	0.028	1.240	1.460	--	110.00	163.25			181.66			1964	60578
		0.03			218.0	4.010	0.028	0.730	1.000	--	148.00	161.80*			192.94*			1964	60578
		0.03			218.0	4.010	0.028	1.720	1.950	--	85.80	159.53			176.70			1964	60578
		0.03			218.0	4.010	0.028	0.720	0.890	--	143.00	155.17			174.41*			1964	60578
		0.03			218.0	4.010	0.028	1.320	1.650	--	104.00	160.62			187.39*			1964	60578
		0.03			218.0	4.010	0.028	1.240	1.550	--	112.00	166.22			192.84*			1964	60578
		0.03			218.0	4.010	0.028	1.730	2.100	--	80.10	149.60			176.38			1964	60578
		0.03			218.0	4.020	0.028	1.270	1.730	--	108.00	162.67			201.57*			1964	60578

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.

TABLE 5.9.2.2 (CONCLUDED)

INCONEL 718 K <sub>G</sub>																				
CONDITION AT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH		GROSS STRESS		K <sub>app</sub>			K <sub>G</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>o</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi) √(in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>G</sub> (Ksi) √(in.)	K <sub>G</sub> MEAN	STAN DEV			
BUCKLING OF CRACK EDGES NOT RESTRAINED																				
Cold Rolled 30 Percent and Aged	Sheet	0.03	R.T.	L-T	218.0	17.930	0.026	5.480	5.880	---	64.40	200.83	197.0	233.26	224.6	11.1	1964	60578		
		0.03			218.0	17.930	0.026	5.480	5.880	---	64.30	200.31		209.48			1964	60578		
		0.03			218.0	17.940	0.026	5.470	6.820	---	65.50	203.81		235.75			1964	60578		
		0.03			218.0	18.080	0.026	5.480	6.680	---	61.30	190.77		217.14			1964	60578		
		0.03			218.0	18.080	0.026	5.470	7.200	---	60.90	189.31		227.47			1964	60578		

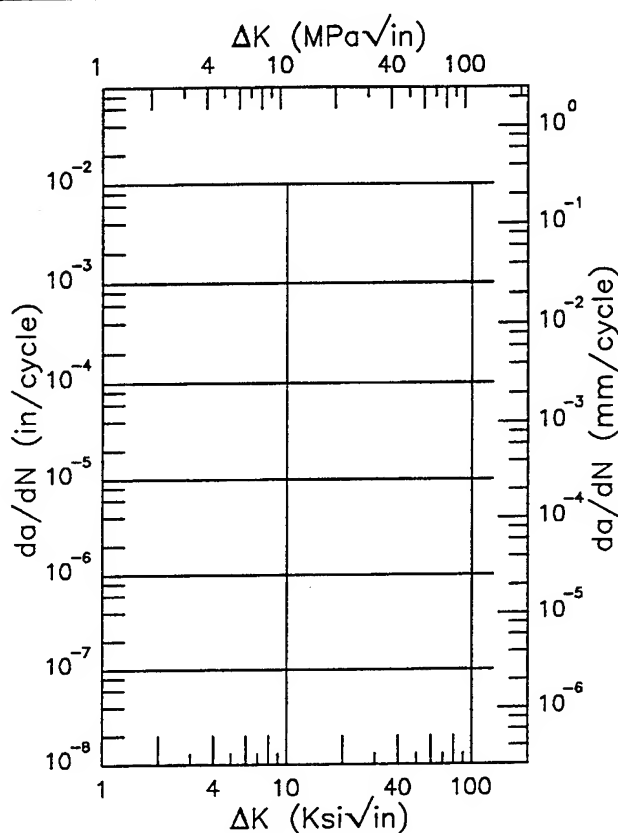
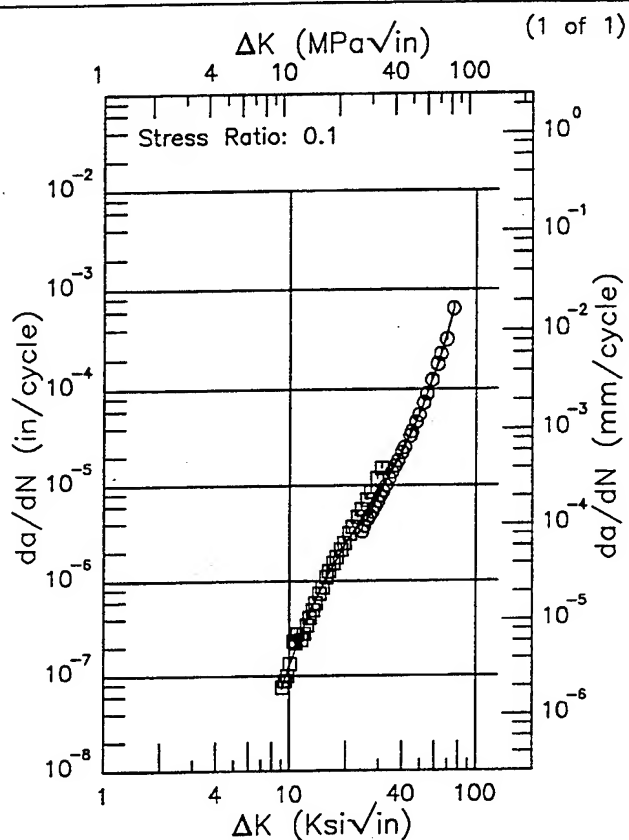


**This page intentionally left blank**

# R INCONEL 718

Condition/Ht:  
Form:  
Specimen Type: CT  
Orientation: L-T  
Frequency: 10 Hz  
Environment: LAB AIR; RT

Yield Strength:  
Ult. Strength:  
Specimen Thk: 0.25 in.  
Specimen Width: 2 in.  
Ref: NC005



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
9.10 (min)	0.0720
10.	0.129
13.	0.498
16.	1.15
20.	2.46
25.	4.86
30.	8.44
35.	13.9
40.	22.3
50.	56.8
60.	145.
70.	374.
75.14 (max)	612.

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS  $\%$   
Error  
17.15

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

RMS  $\%$   
Error

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

Figure 5.9.3.1.1

Condition/Ht: 1325F 8HRS FC TO 1150F  
 Form: 4 in. Forging  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 6 Hz  
 Environment: L.H.A.; RT

Yield Strength: 168 ksi  
 Ult. Strength: 199 ksi  
 Specimen Thk: 0.54 - 0.55 in.  
 Specimen Width: 7.4 in.  
 Ref: 88579

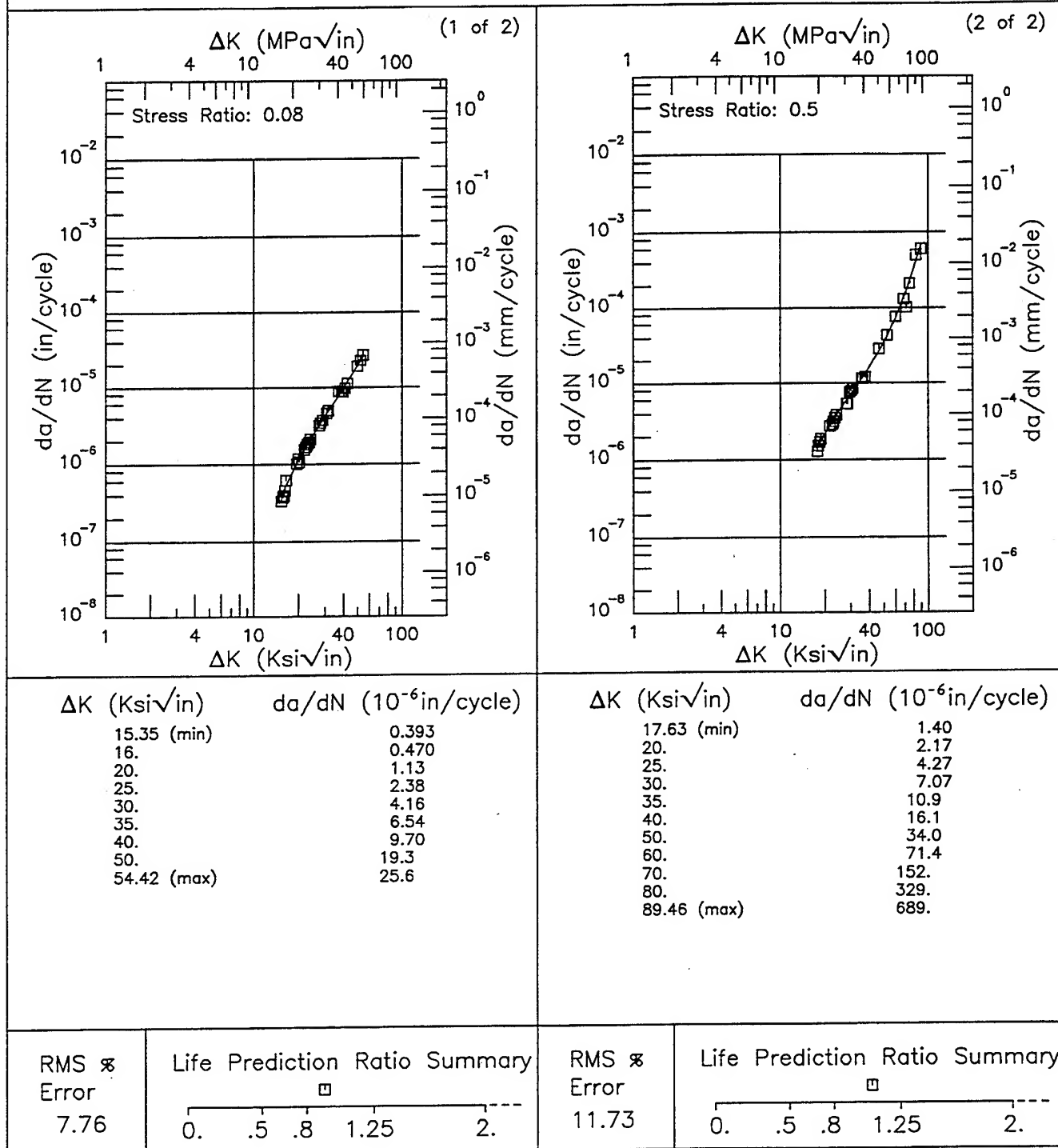
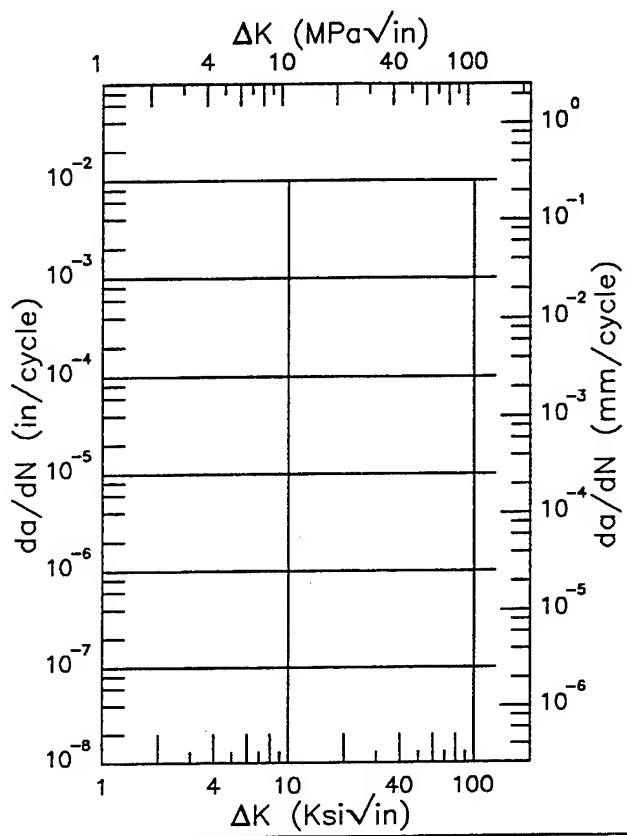
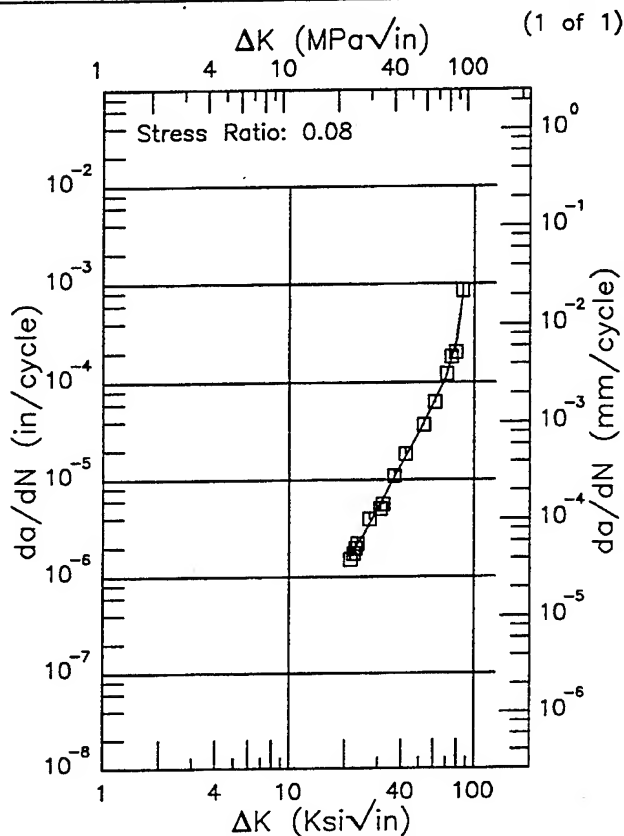


Figure 5.9.3.1.2

# R INCONEL 718

Condition/Ht: 1325F 8HRS FC TO 1150F  
 Form: 4 in. Forging  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 6 Hz  
 Environment: L.H.A.; RT

Yield Strength: 166 ksi  
 Ult. Strength: 197 ksi  
 Specimen Thk: 0.51 in.  
 Specimen Width: 6.01 in.  
 Ref: 88579



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
21.31 (min)	1.65
25.	2.68
30.	5.10
35.	8.98
40.	14.4
50.	30.9
60.	60.4
70.	113.
80.	265.
86.24 (max)	822.

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS  $\propto$   
 Error  
 8.08

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

RMS  $\propto$   
 Error

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

**Figure 5.9.3.1.3**

Condition/Ht: 1750F 1HR AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.05

Yield Strength: 147.9 ksi  
 Ult. Strength: 191.3 ksi  
 Specimen Thk: 0.298 - 0.49 in.  
 Specimen Width: 1.153 - 1.998 in.  
 Ref: HD016

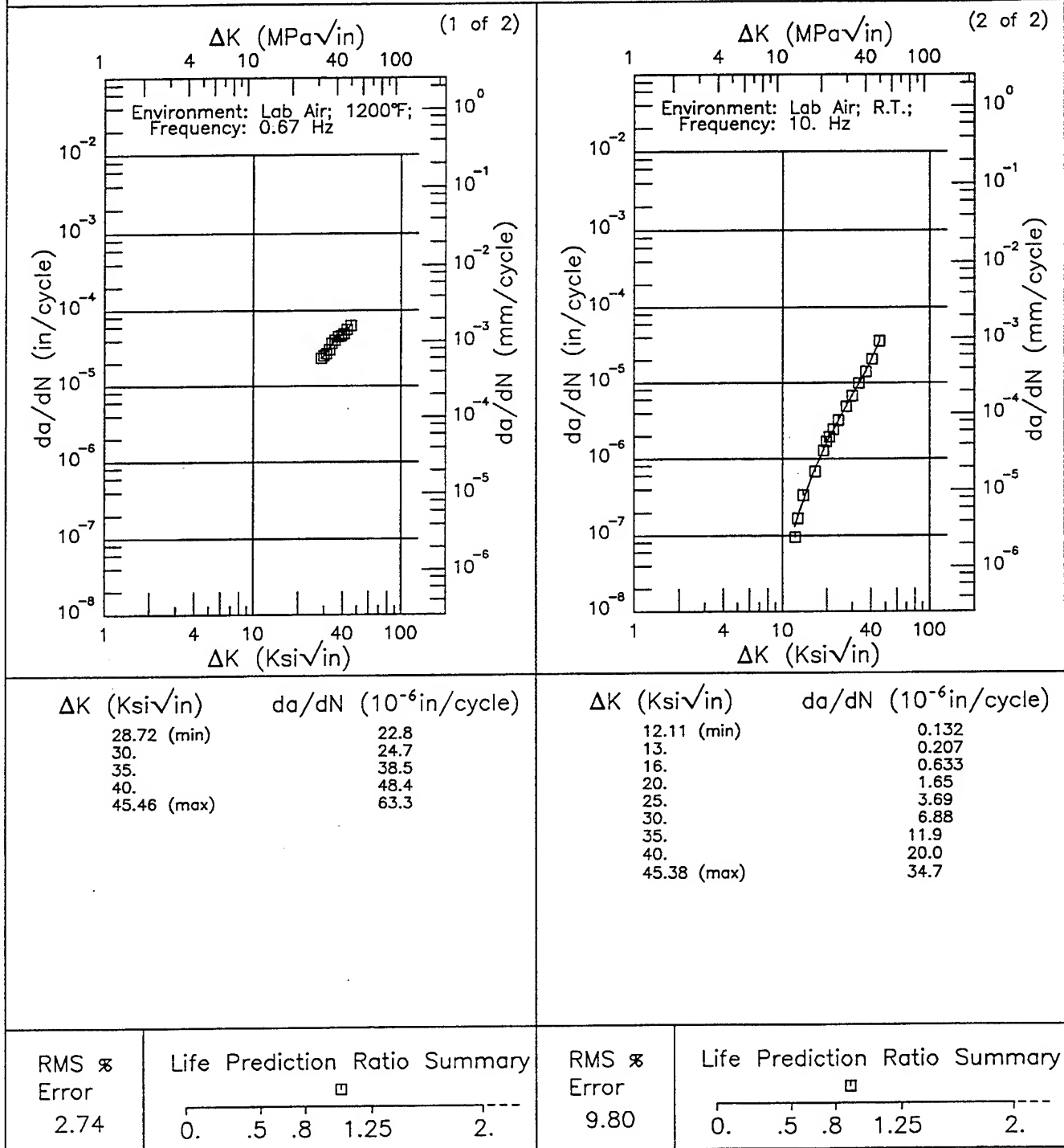


Figure 5.9.3.1.4

# E INCONEL 718

Condition/Ht: 1750F 1HR AC 1325F  
 Form: 0.63 in. Forged Bar  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 164.9 ksi  
 Ult. Strength: 208.1 ksi  
 Specimen Thk: 0.3 - 0.302 in.  
 Specimen Width: 1.152 - 1.153 in.  
 Ref: HD016

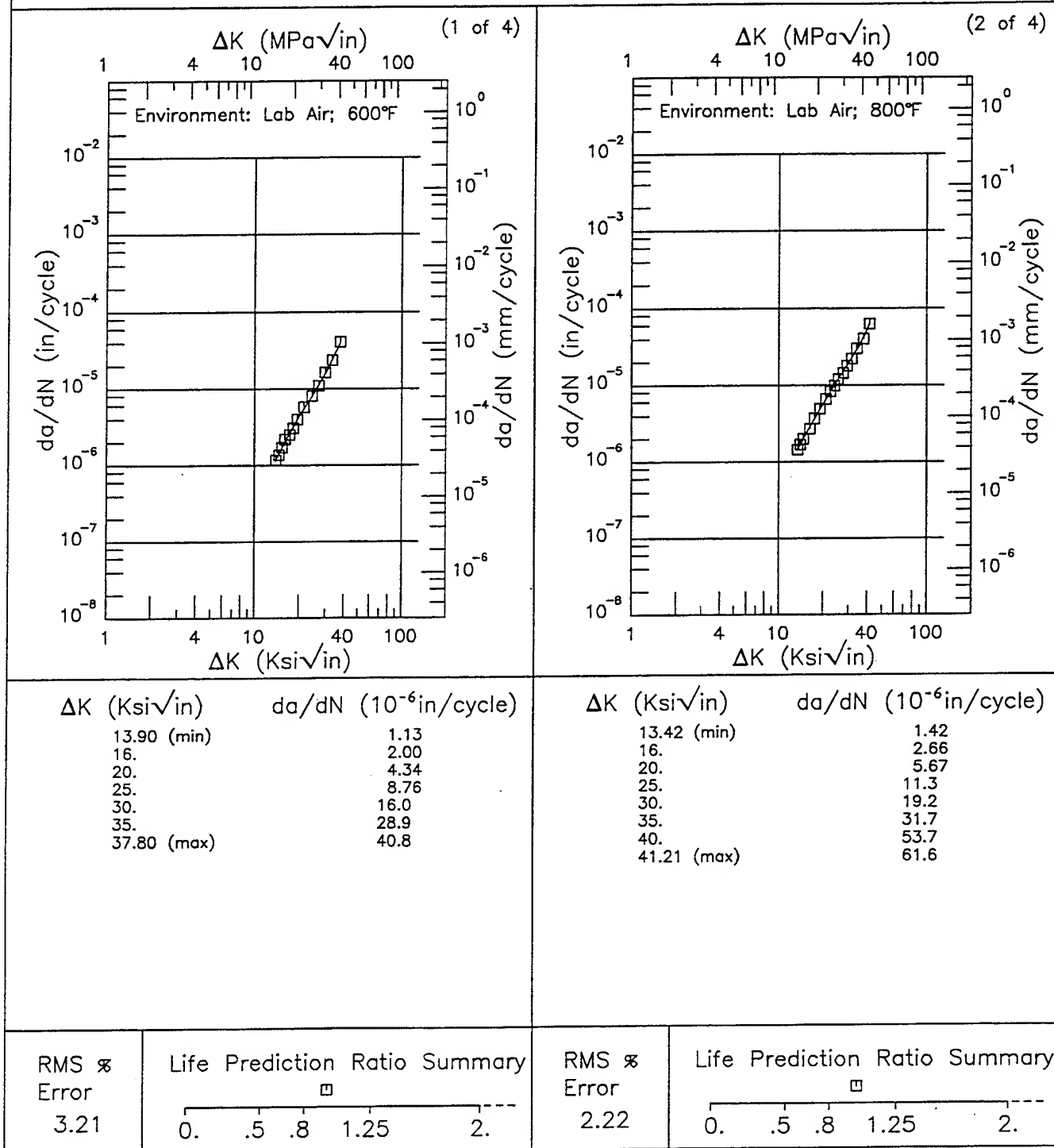


Figure 5.9.3.1.5

Condition/Ht: 1750F 1HR AC 1325F  
 Form: 0.63 in. Forged Bar  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 164.9 ksi  
 Ult. Strength: 208.1 ksi  
 Specimen Thk: 0.3 - 0.302 in.  
 Specimen Width: 1.152 - 1.153 in.  
 Ref: HD016

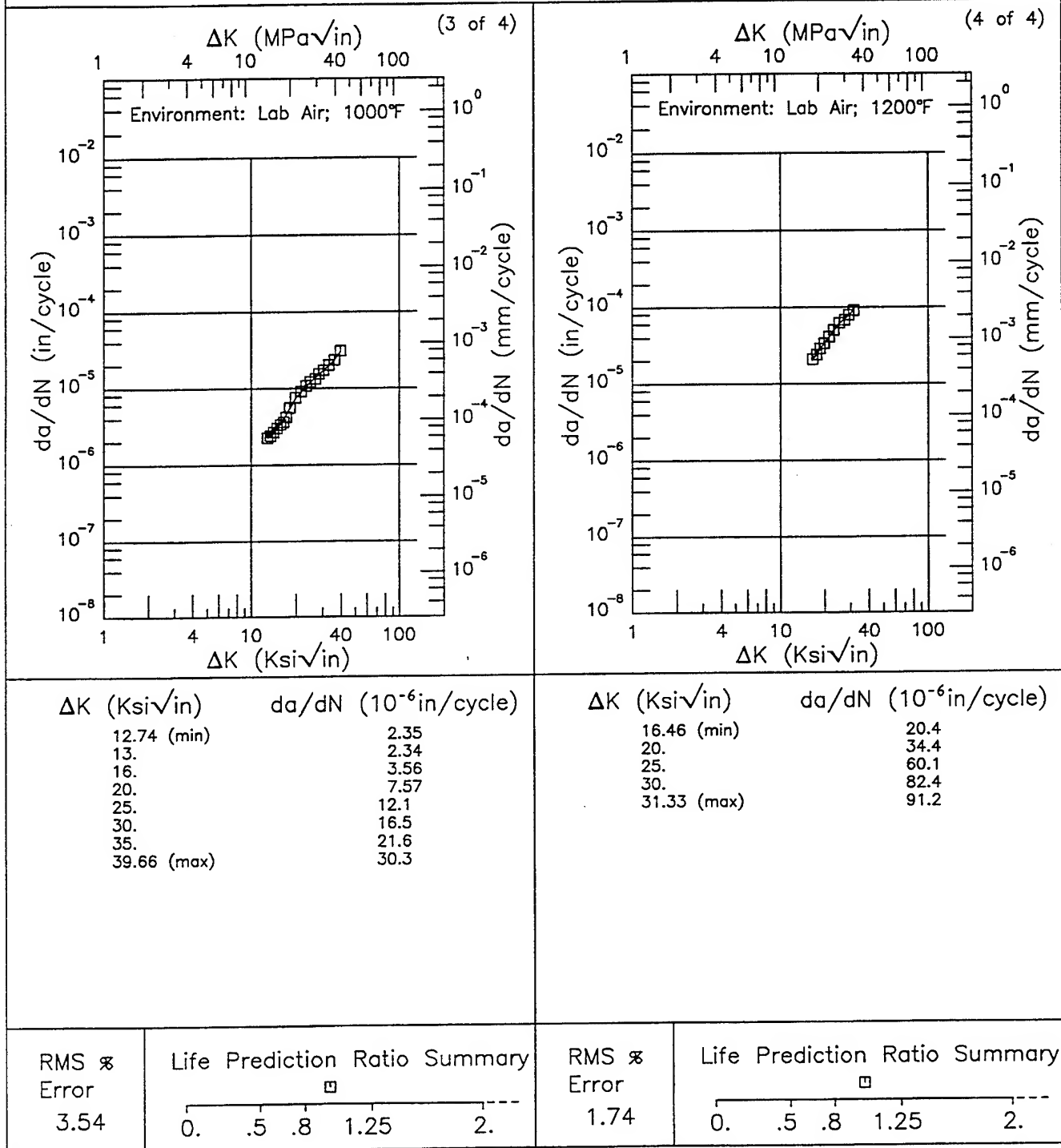


Figure 5.9.3.1.5 (Concluded)

# E INCONEL 718

Condition/Ht: 1750F 1HR AC 1325F  
 Form: 0.63 in. Forged Bar  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.05  
 Frequency: 8.3 - 10 Hz

Yield Strength: 164.9 ksi  
 Ult. Strength: 208.1 ksi  
 Specimen Thk: 0.301 in.  
 Specimen Width: 1.151 in.  
 Ref: HD016

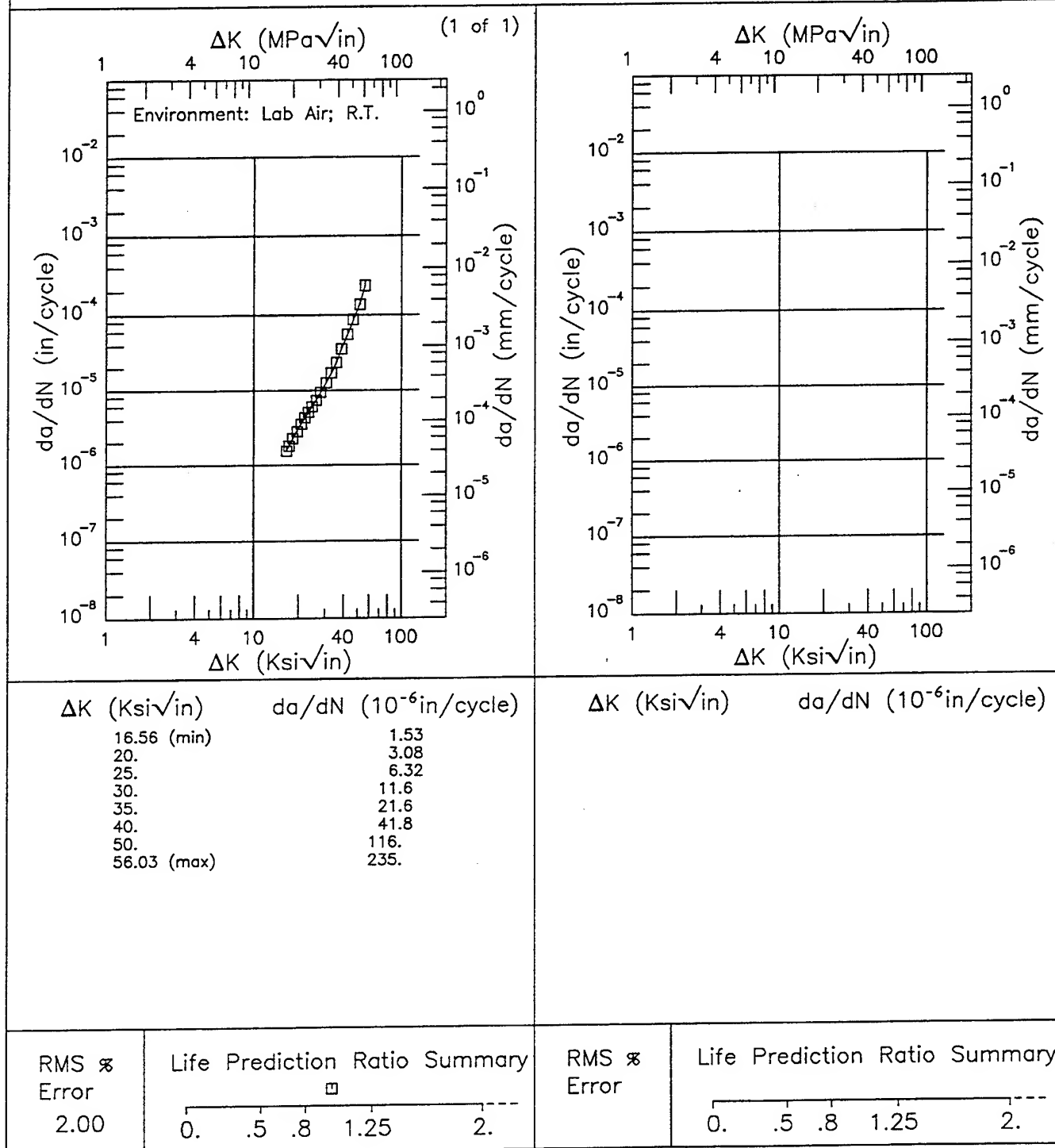
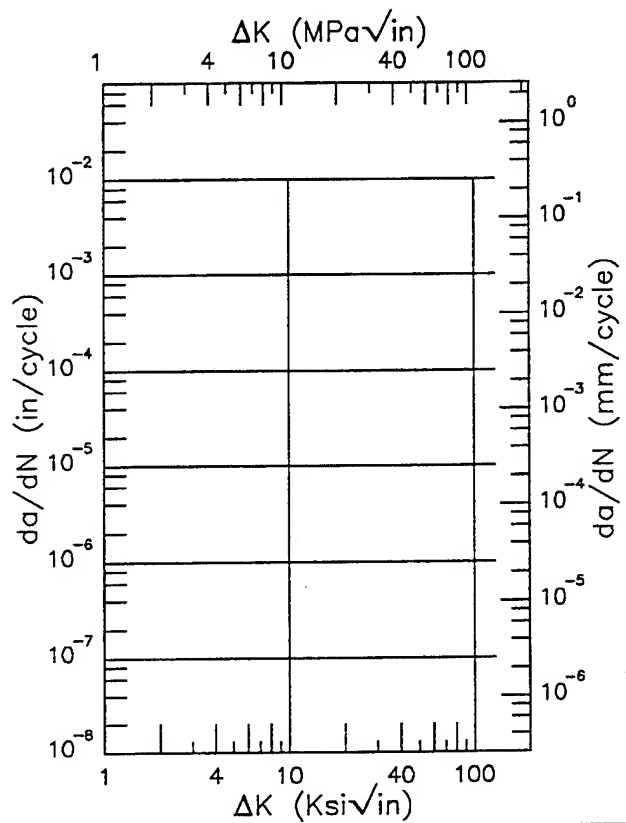
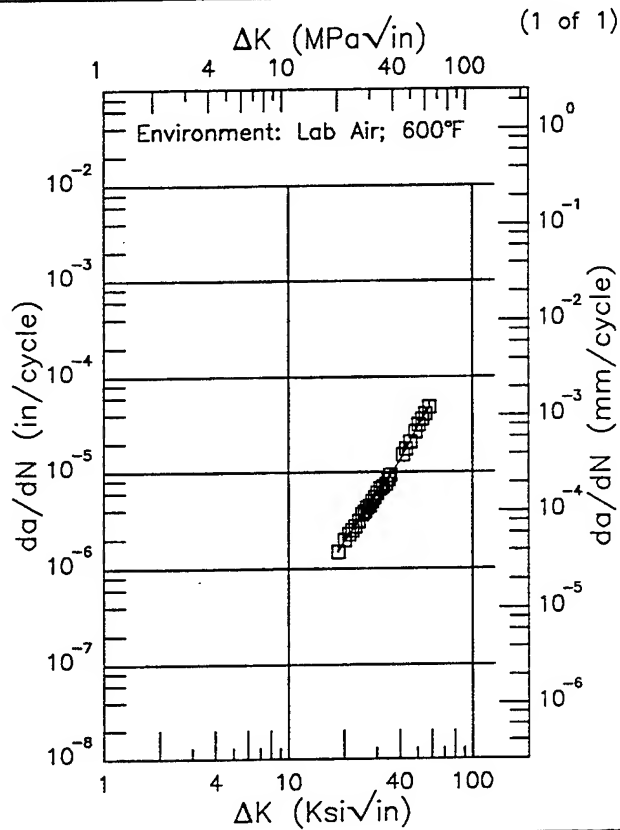


Figure 5.9.3.1.6



Condition/Ht: 1750F AC  
 Form: 0.06 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 174 ksi  
 Ult. Strength: 204.1 ksi  
 Specimen Thk: 0.061 in.  
 Specimen Width: 1.995 in.  
 Ref: HD017



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
18.40 (min)	1.50
20.	1.90
25.	3.53
30.	5.73
35.	8.69
40.	13.1
50.	29.2
57.54 (max)	46.5

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )      da/dN (10<sup>-6</sup>in/cycle)

RMS %  
 Error  
 2.11

Life Prediction Ratio Summary

□

0. .5 .8 1.25 2.

RMS %  
 Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 5.9.3.1.7

# E INCONEL 718

Condition/Ht: 1750F AC 1325F  
 Form: 0.06 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 174 ksi  
 Ult. Strength: 204.1 ksi  
 Specimen Thk: 0.061 in.  
 Specimen Width: 1.999 - 2 in.  
 Ref: HD017

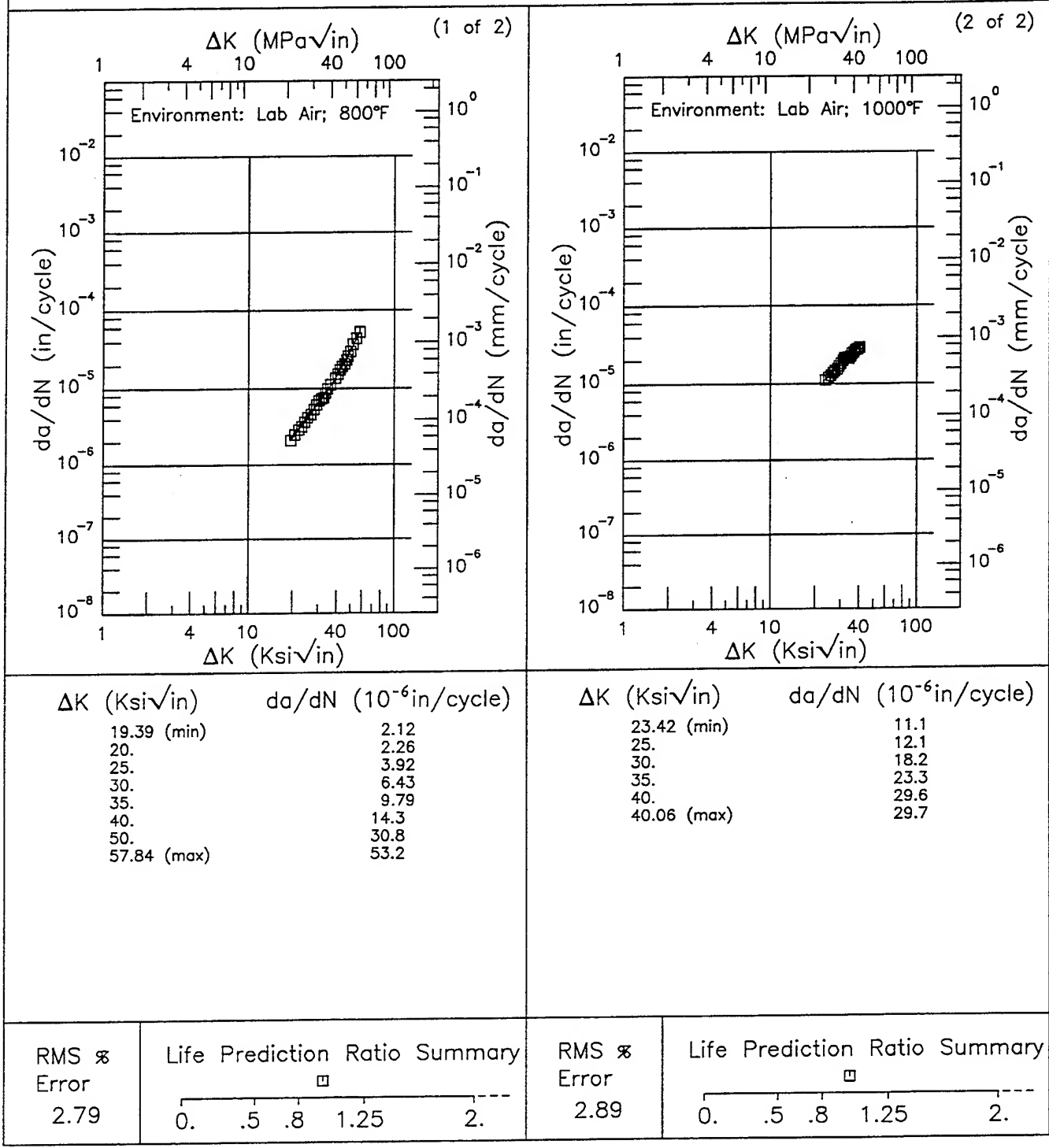


Figure 5.9.3.1.8

5-96

Condition/Ht: 1750F AC 1325F  
 Form: 0.06 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 5 Hz

Yield Strength: 174 ksi  
 Ult. Strength: 204.1 ksi  
 Specimen Thk: 0.061 in.  
 Specimen Width: 1.994 in.  
 Ref: HD017

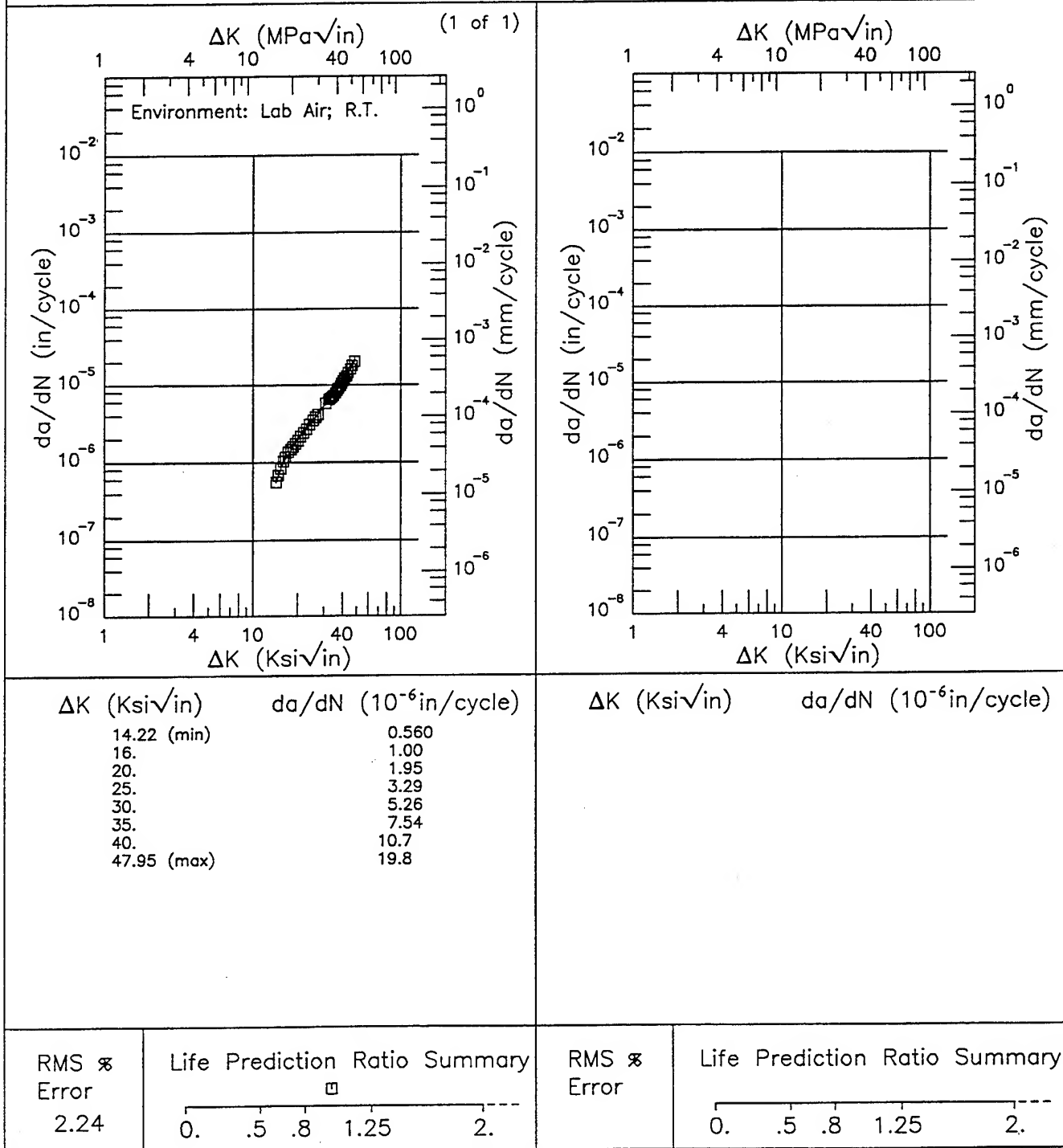


Figure 5.9.3.1.9

R

# INCONEL 718

Condition/Ht: 1750F AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation:  
 Frequency: 6.7 Hz  
 Environment: LAB AIR;1000°F

Yield Strength: 150.5 ksi  
 Ult. Strength: 191.3 ksi  
 Specimen Thk: 0.298 – 0.299 in.  
 Specimen Width: 1.152 in.  
 Ref: HD015

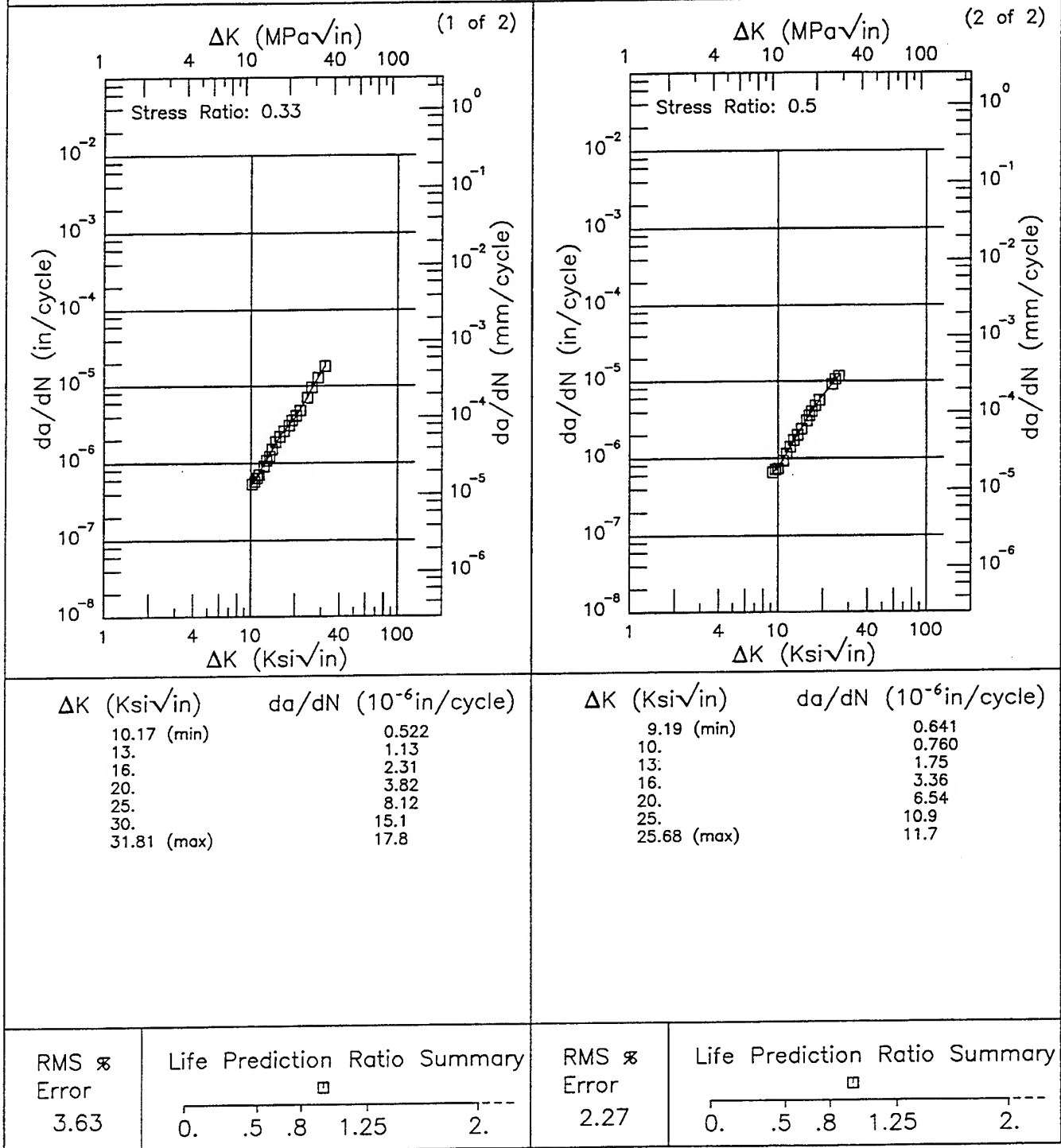


Figure 5.9.3.1.10

**This page intentionally left blank**

# E INCONEL 718

Condition/Ht: 1750F AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 150.5 - 156.4 ksi  
 Ult. Strength: 191.3 - 200.7 ksi  
 Specimen Thk: 0.299 - 0.497 in.  
 Specimen Width: 1.152 - 1.999 in.  
 Ref: HD015;HD017

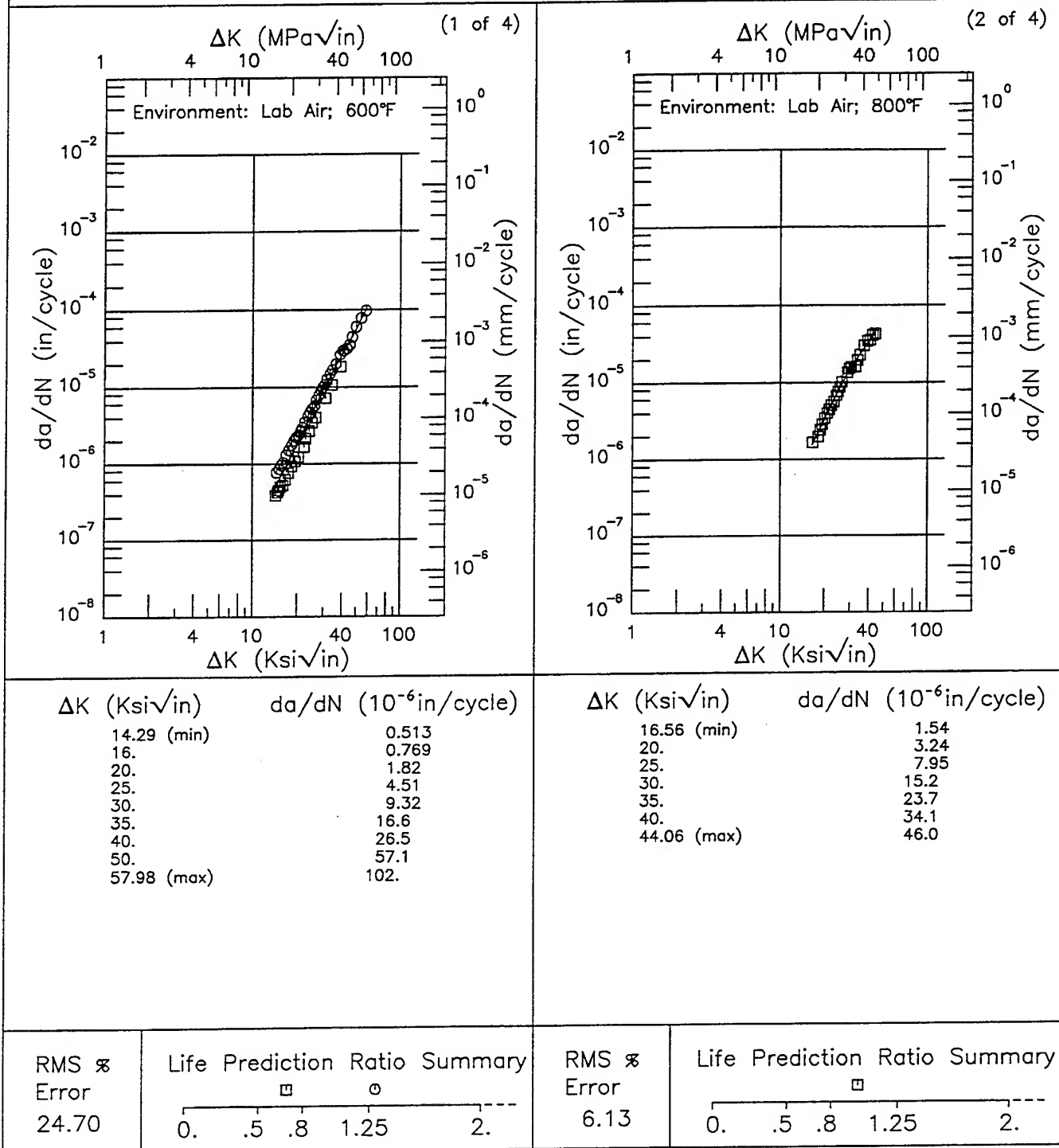


Figure 5.9.3.1.11

Condition/Ht: 1750F AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 150.5 - 156.4 ksi  
 Ult. Strength: 191.3 - 200.7 ksi  
 Specimen Thk: 0.299 - 0.497 in.  
 Specimen Width: 1.152 - 1.999 in.  
 Ref: HD015;HD017

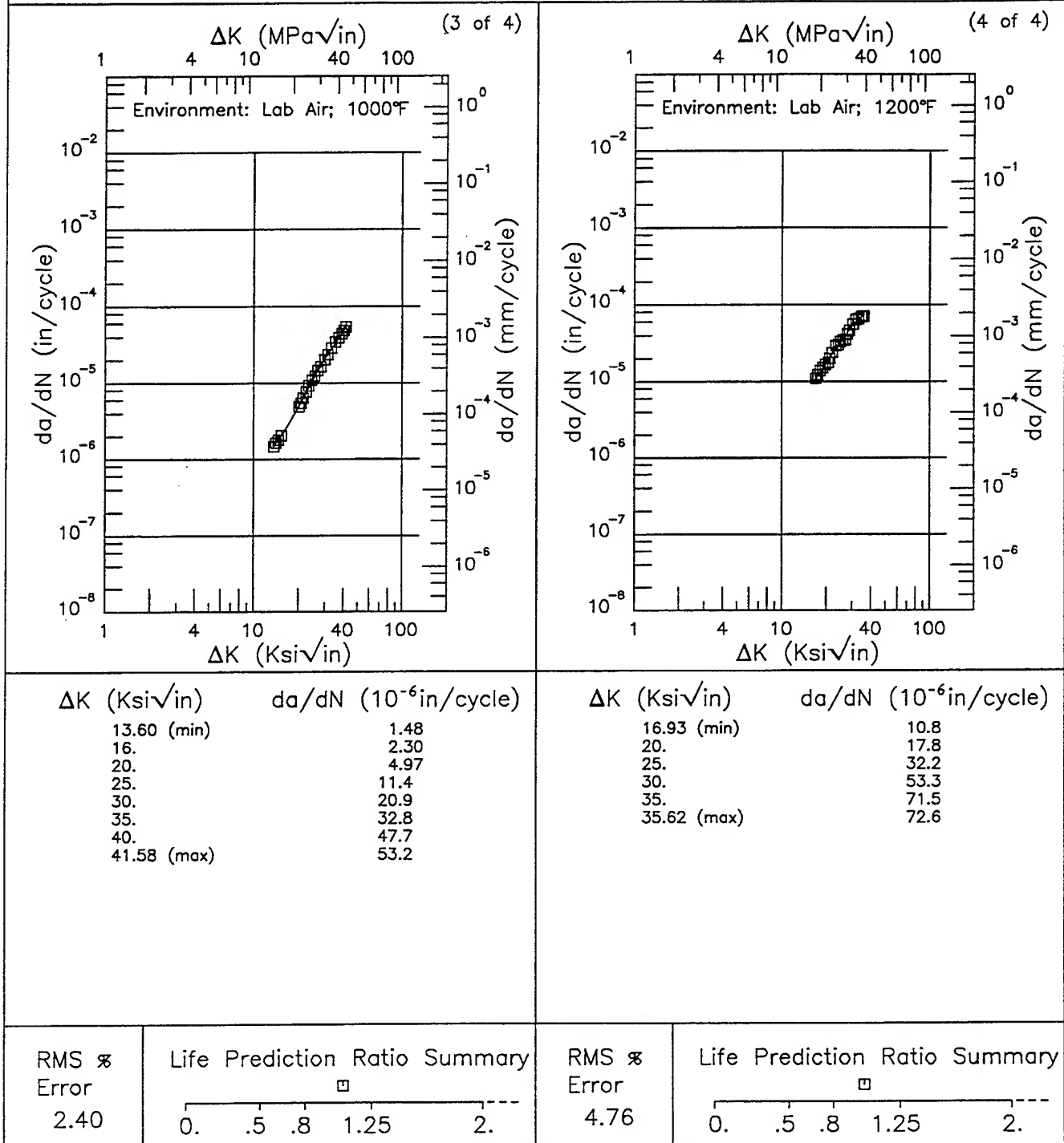


Figure 5.9.3.1.11 (Concluded)

# INCONEL 718

Condition/Ht: 1750F AC 1325F 8HRS FC TO 1150F HELD 18HRS AC  
Form: 0.5 in. Plate  
Specimen Type: CT  
Orientation:  
Stress Ratio: 0.05

Yield Strength: 150.5 – 156.4 ksi  
Ult. Strength: 191.3 – 200.7 ksi  
Specimen Thk: 0.298 – 0.495 in.  
Specimen Width: 1.151 – 1.998 in.  
Ref: HD017;HD015

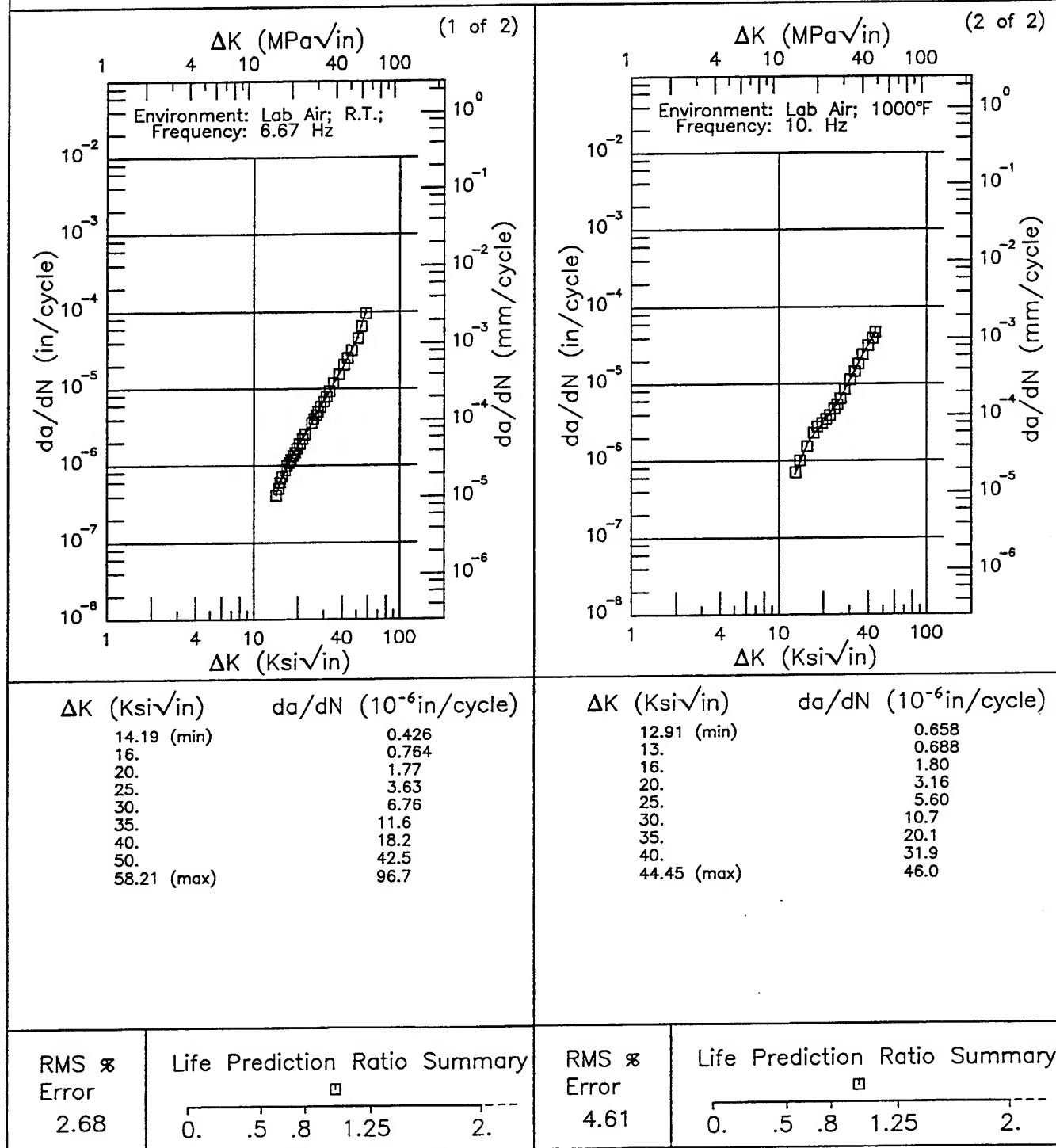


Figure 5.9.3.1.12



Condition/Ht: 1750F AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 0.7 Hz  
 Environment: LAB AIR;1200°F

Yield Strength: 150.5 ksi  
 Ult. Strength: 191.3 ksi  
 Specimen Thk: 0.477 in.  
 Specimen Width: 1.997 in.  
 Ref: HD015

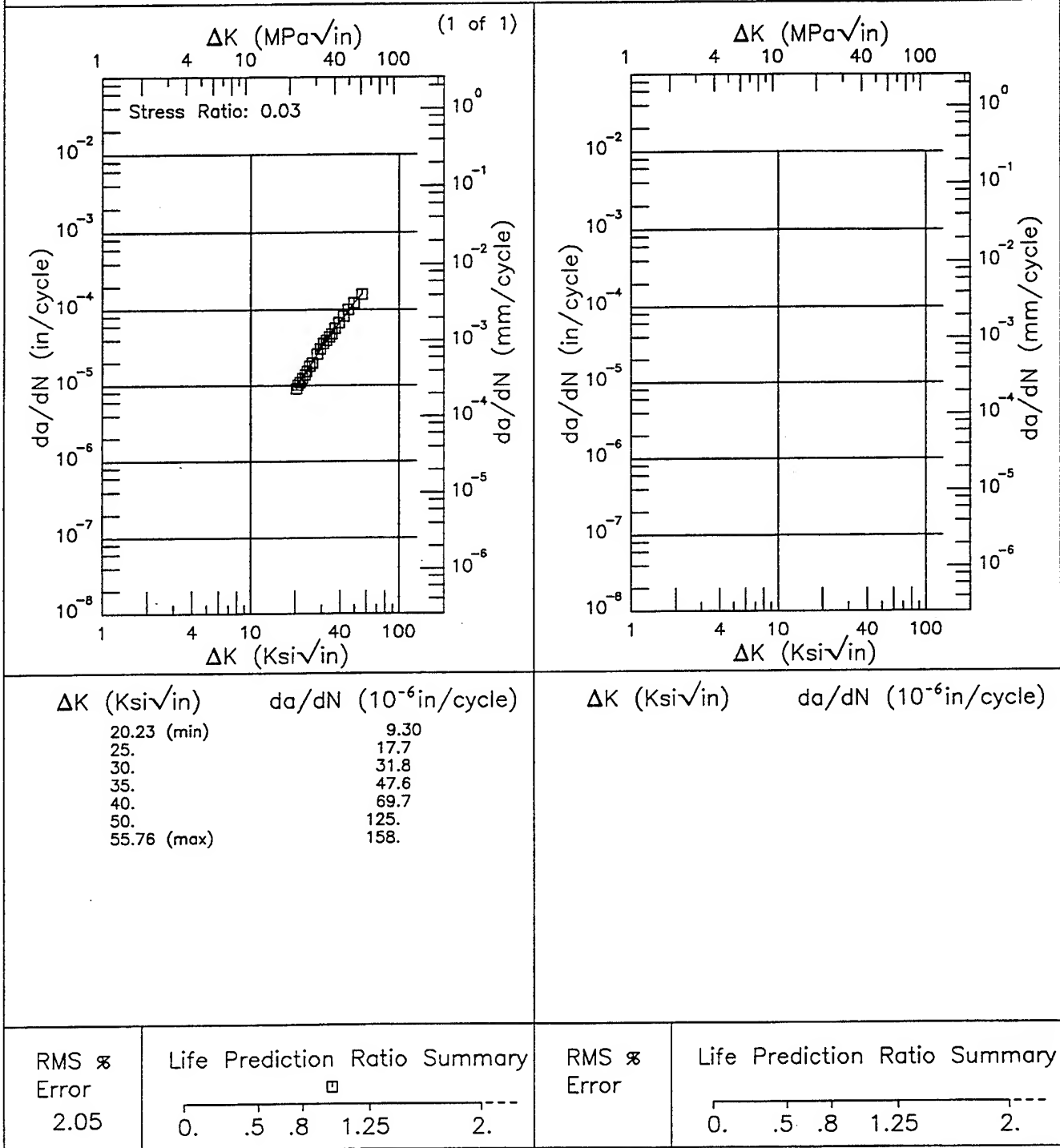


Figure 5.9.3.1.13

R

# INCONEL 718

Condition/Ht: 1750F AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 6.7 Hz  
 Environment: LAB AIR;800°F

Yield Strength: 150.5 ksi  
 Ult. Strength: 191.3 ksi  
 Specimen Thk: 0.477 - 0.478 in.  
 Specimen Width: 1.996 in.  
 Ref: HD015

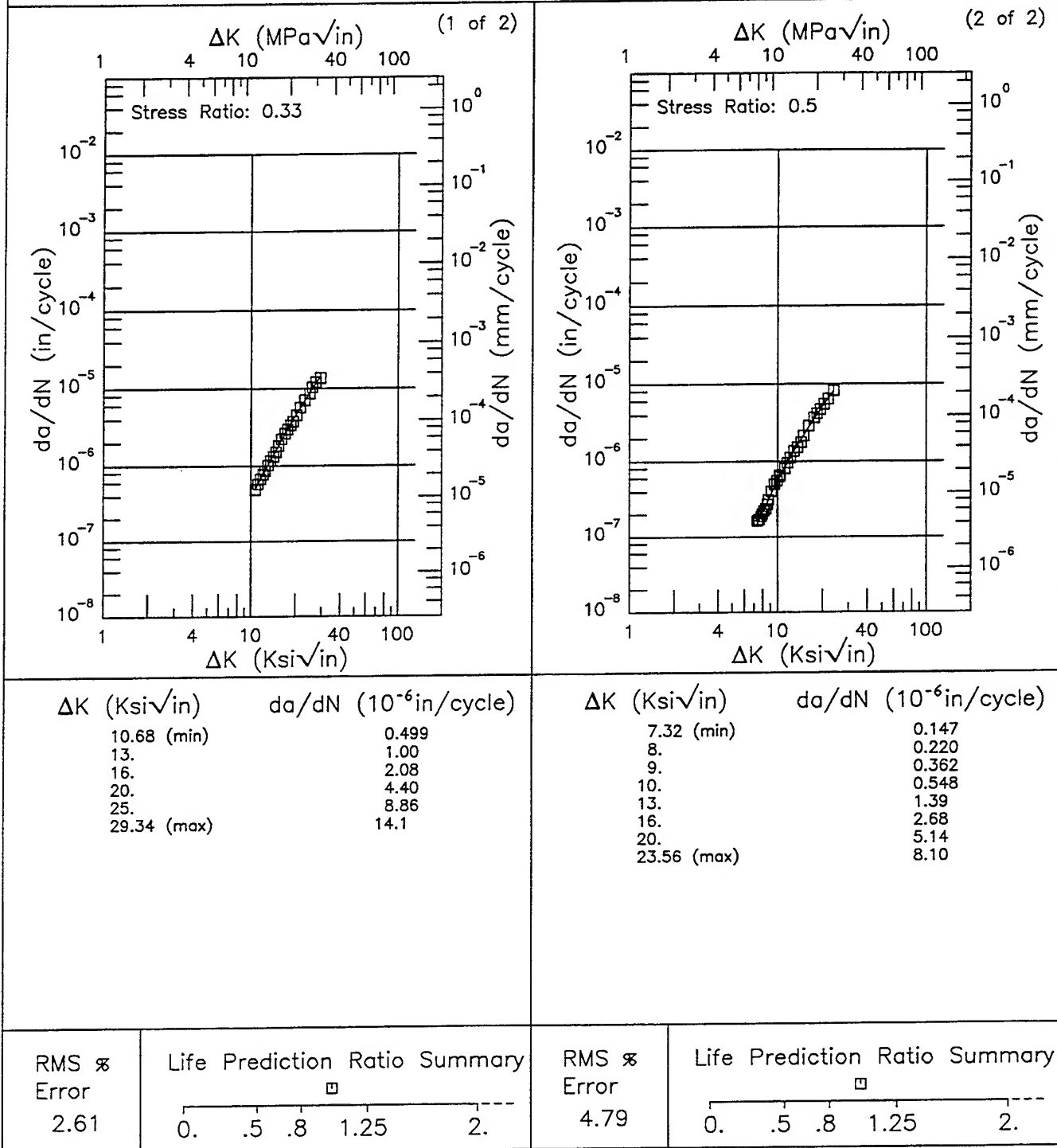


Figure 5.9.3.1.14

Condition/Ht: 1750F AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 6.7 Hz  
 Environment: LAB AIR;1000°F

Yield Strength: 150.5 ksi  
 Ult. Strength: 191.3 ksi  
 Specimen Thk: 0.479 in.  
 Specimen Width: 1.993 in.  
 Ref: HD015

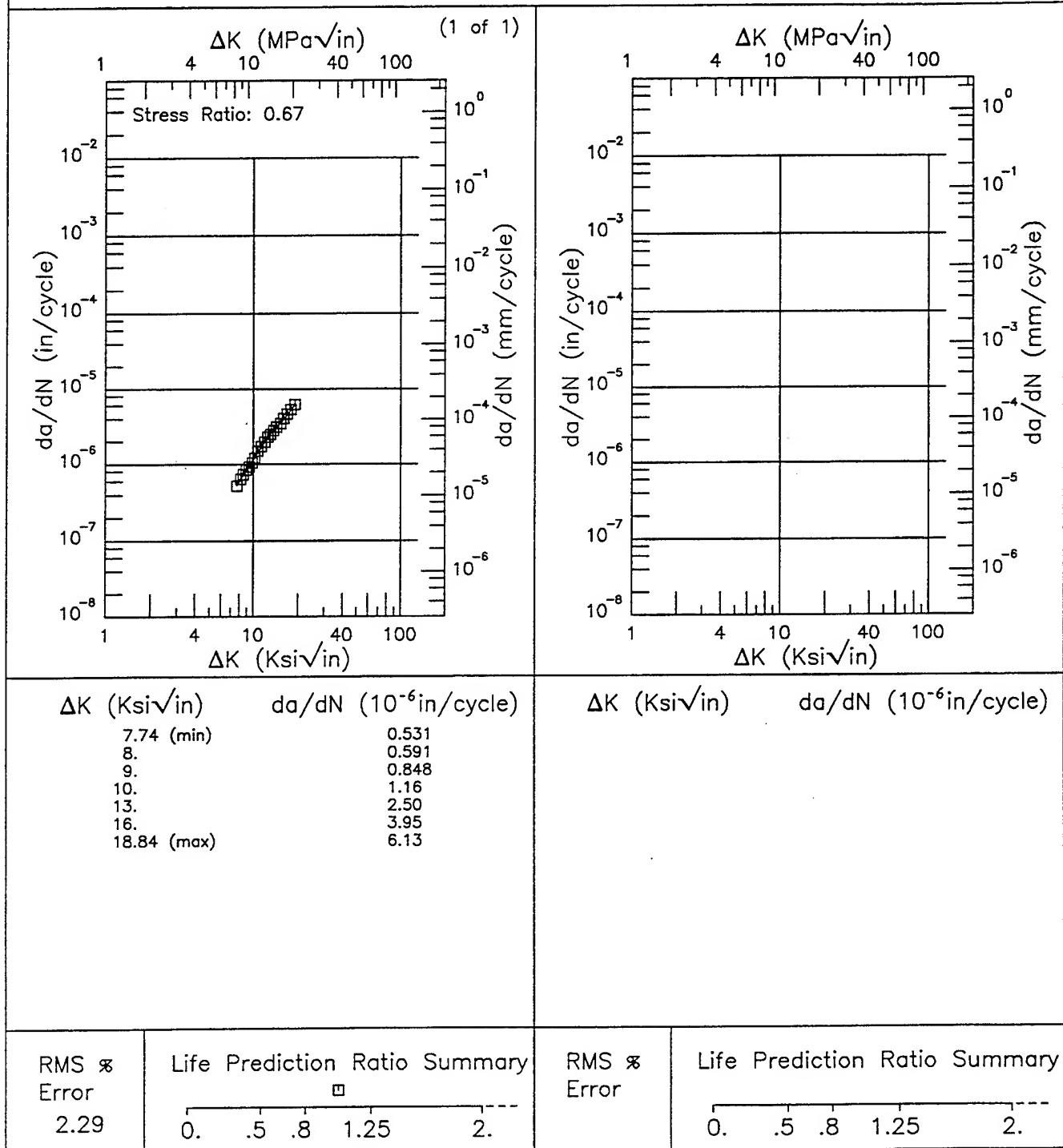
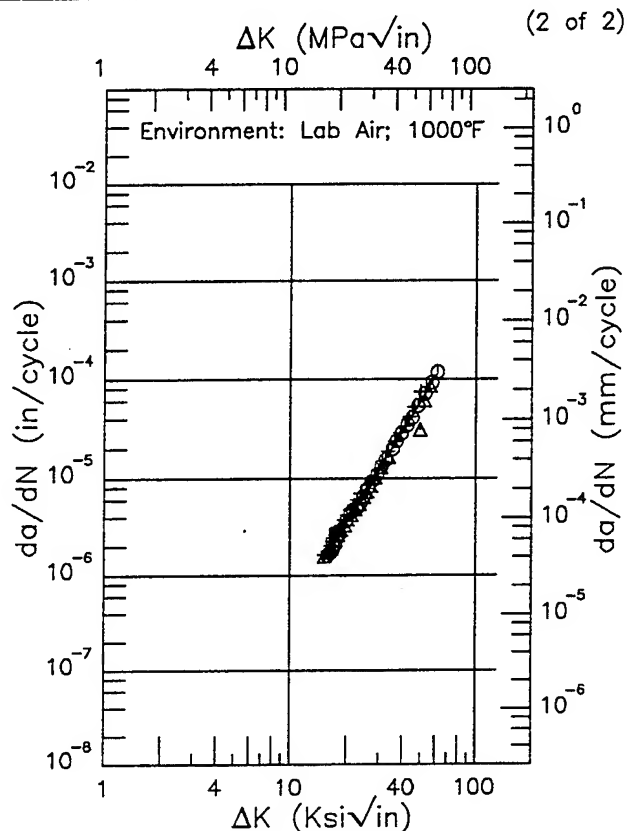
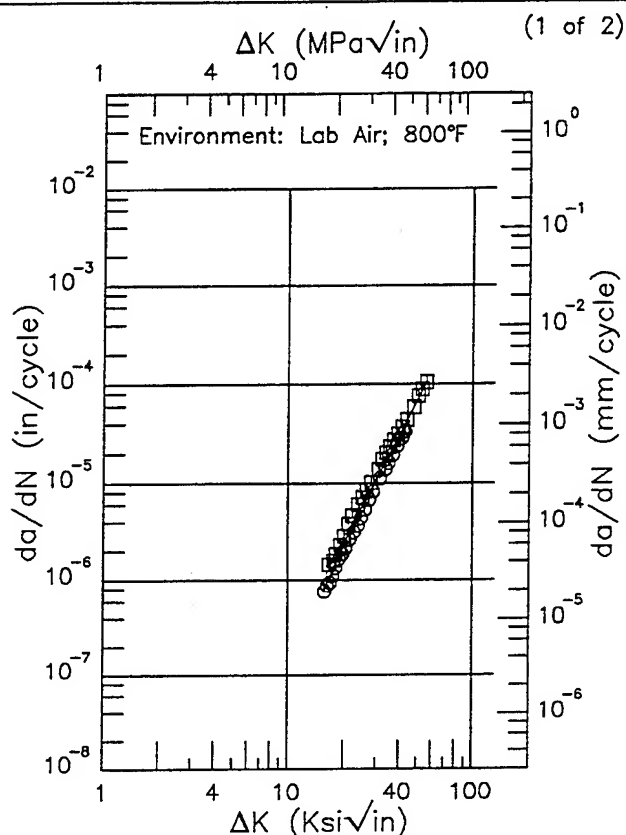


Figure 5.9.3.1.15

# E INCONEL 718

Condition/Ht: 1750F AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.05  
 Frequency: 0.7 - 6.7 Hz

Yield Strength: 150.5 ksi  
 Ult. Strength: 191.3 ksi  
 Specimen Thk: 0.476 - 0.478 in.  
 Specimen Width: 1.996 - 1.998 in.  
 Ref: HD015



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
15.64 (min)	0.781
16.	0.871
20.	2.34
25.	5.62
30.	10.9
35.	18.8
40.	30.1
50.	68.5
56.07 (max)	107.

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
15.20 (min)	1.52
16.	1.79
20.	3.62
25.	7.18
30.	12.5
35.	19.9
40.	29.8
50.	59.2
60.	106.
61.27 (max)	113.

RMS %  
 Error  
 17.42

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
 Error  
 9.25

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 5.9.3.1.16

Condition/Ht: 1750F AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 129 ksi  
 Ult. Strength: 160.1 ksi  
 Specimen Thk: 0.476 in.  
 Specimen Width: 1.998 in.  
 Ref: HD015

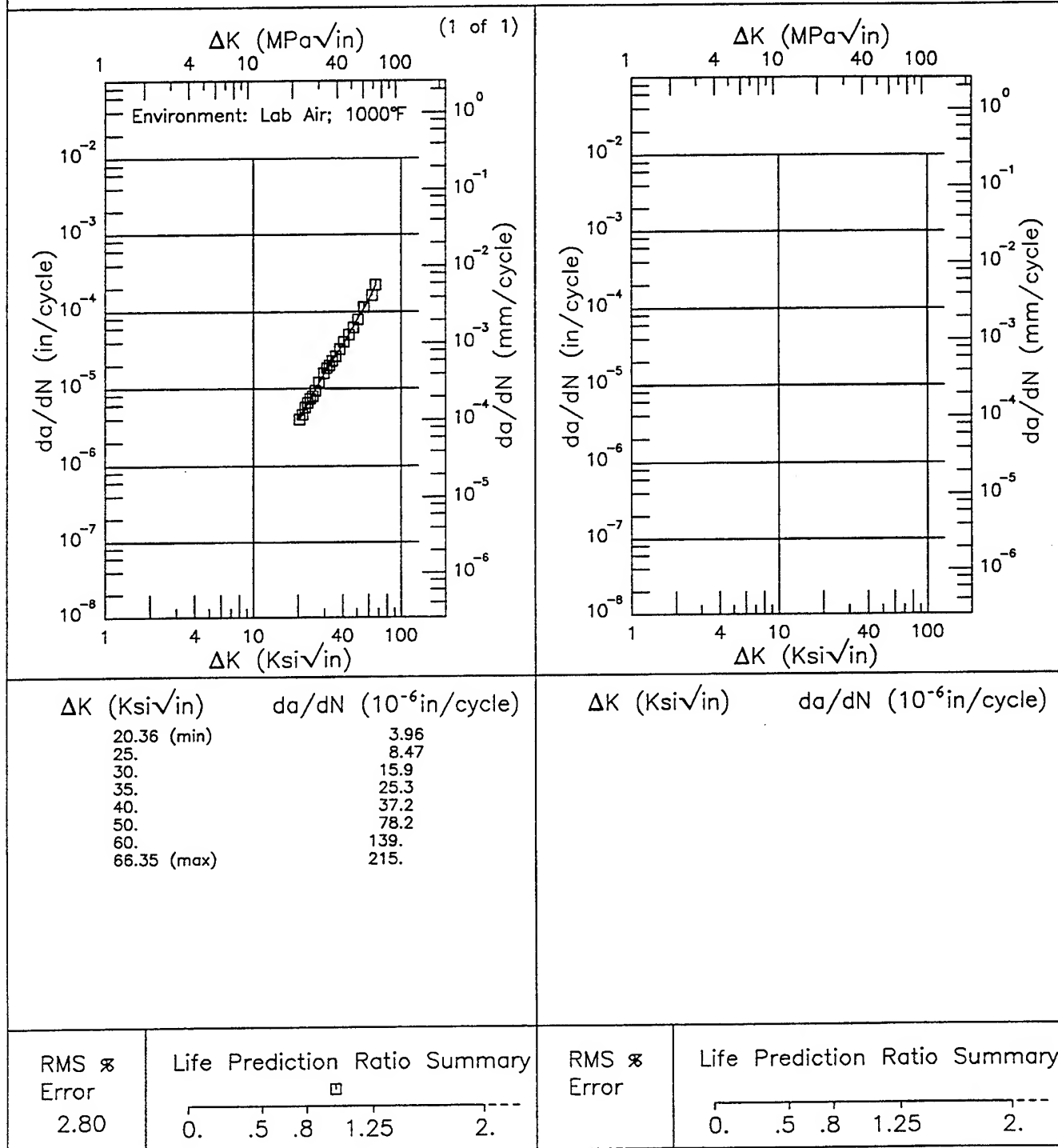
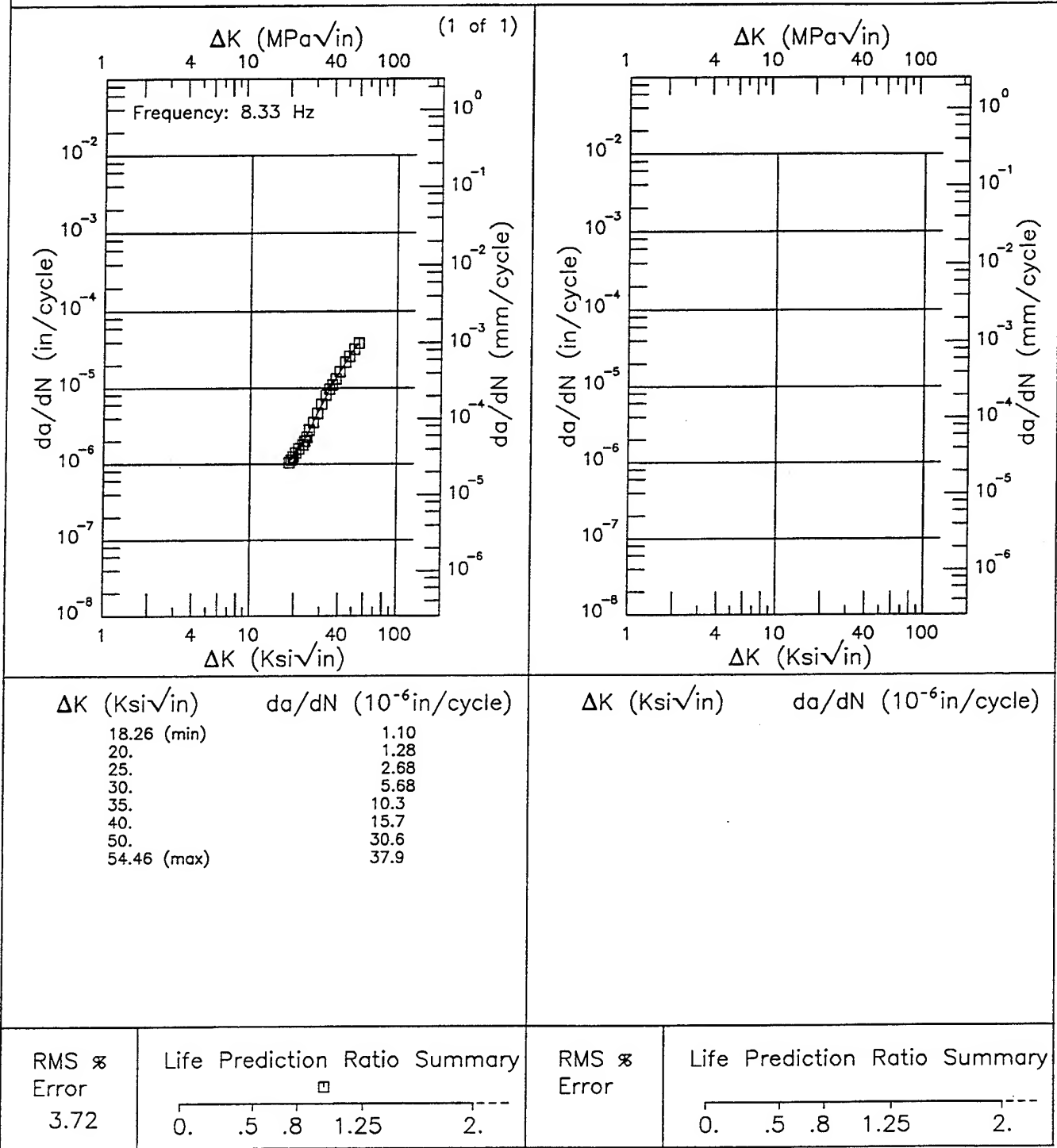


Figure 5.9.3.1.17

# F | INCONEL 718 |

Condition/Ht: 1750F AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.05  
 Environment: LAB AIR; RT

Yield Strength: 150.5 ksi  
 Ult. Strength: 191.3 ksi  
 Specimen Thk: 0.477 in.  
 Specimen Width: 1.998 in.  
 Ref: HD015



**Figure 5.9.3.1.18**

**This page intentionally left blank**

# E INCONEL 718

Condition/Ht: 1750F AC 1325F  
 Form: Forging  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 168.4 ksi  
 Ult. Strength: 196.7 ksi  
 Specimen Thk: 0.402 – 0.403 in.  
 Specimen Width: 1.996 – 1.998 in.  
 Ref: HD017

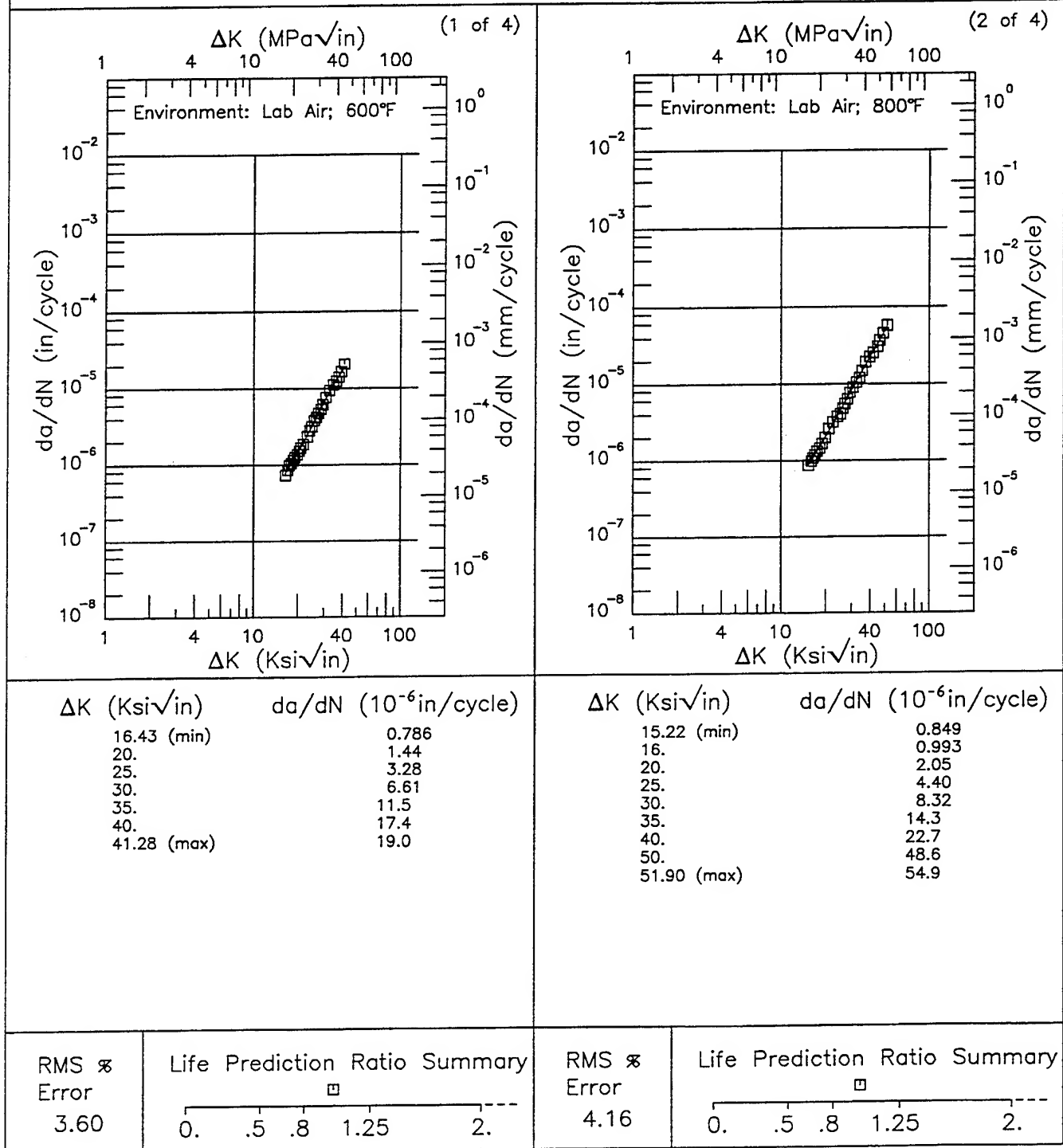


Figure 5.9.3.1.19



Condition/Ht: 1750F AC 1325F  
 Form: Forging  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 168.4 ksi  
 Ult. Strength: 196.7 ksi  
 Specimen Thk: 0.402 - 0.403 in.  
 Specimen Width: 1.996 - 1.998 in.  
 Ref: HD017

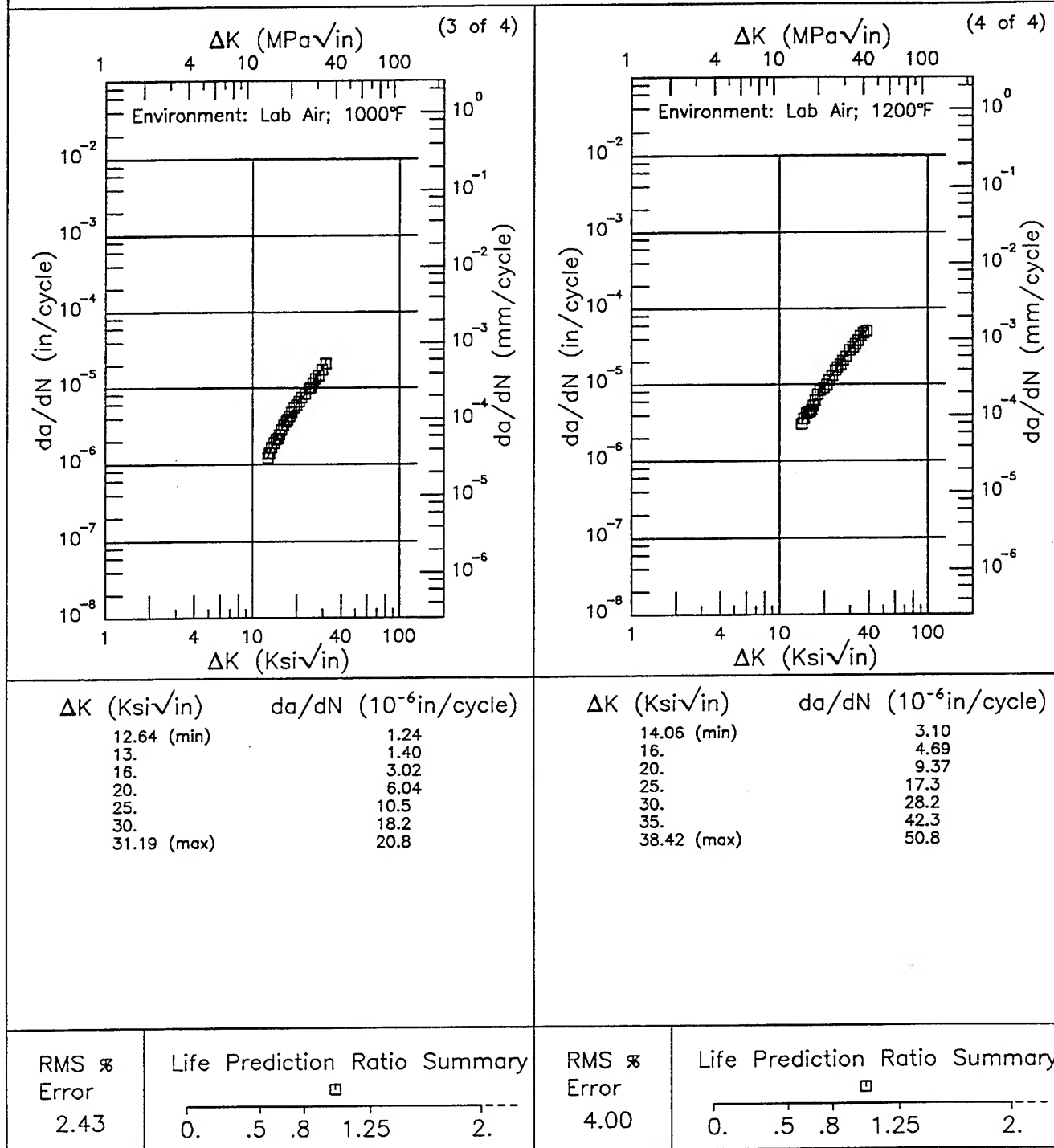
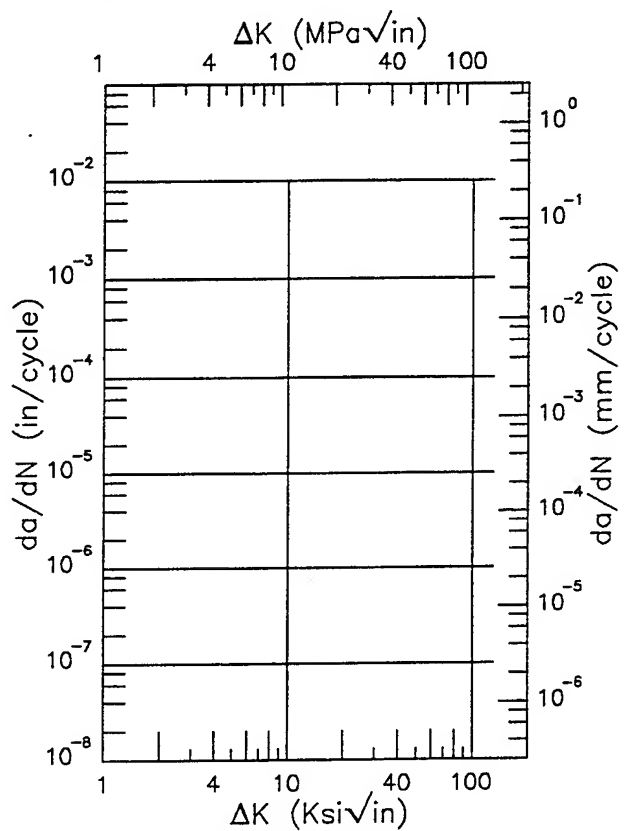
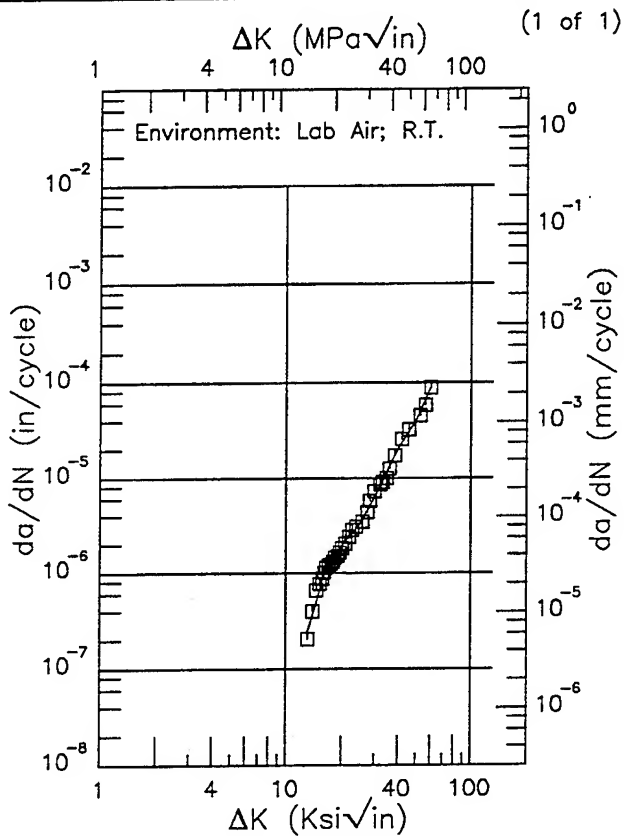


Figure 5.9.3.1.19 (Concluded)

E | INCONEL 718 |  
 Condition/Ht: 1750F AC 1325F  
 Form: Forging  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.05  
 Frequency: 10 Hz

Yield Strength: 168.4 ksi  
 Ult. Strength: 195.7 ksi  
 Specimen Thk: 0.402 in.  
 Specimen Width: 1.998 in.  
 Ref: HD017



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
13.06 (min)	0.238
16.	0.925
20.	1.93
25.	3.33
30.	6.33
35.	12.0
40.	20.6
50.	40.7
59.94 (max)	88.8

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )      da/dN (10<sup>-6</sup>in/cycle)

RMS %  
 Error  
 9.56

Life Prediction Ratio Summary  
  
 0. .5 .8 1.25 2.

RMS %  
 Error

Life Prediction Ratio Summary  
  
 0. .5 .8 1.25 2.

Figure 5.9.3.1.20

Condition/Ht: 1750F AC 1325F  
 Form: 2 in. Forged Bar  
 Specimen Type: CT  
 Orientation: C-R  
 Stress Ratio: 0.05  
 Frequency: 10 Hz

Yield Strength: 152.1 ksi  
 Ult. Strength: 194.4 ksi  
 Specimen Thk: 0.304 in.  
 Specimen Width: 1.48 in.  
 Ref: HD017

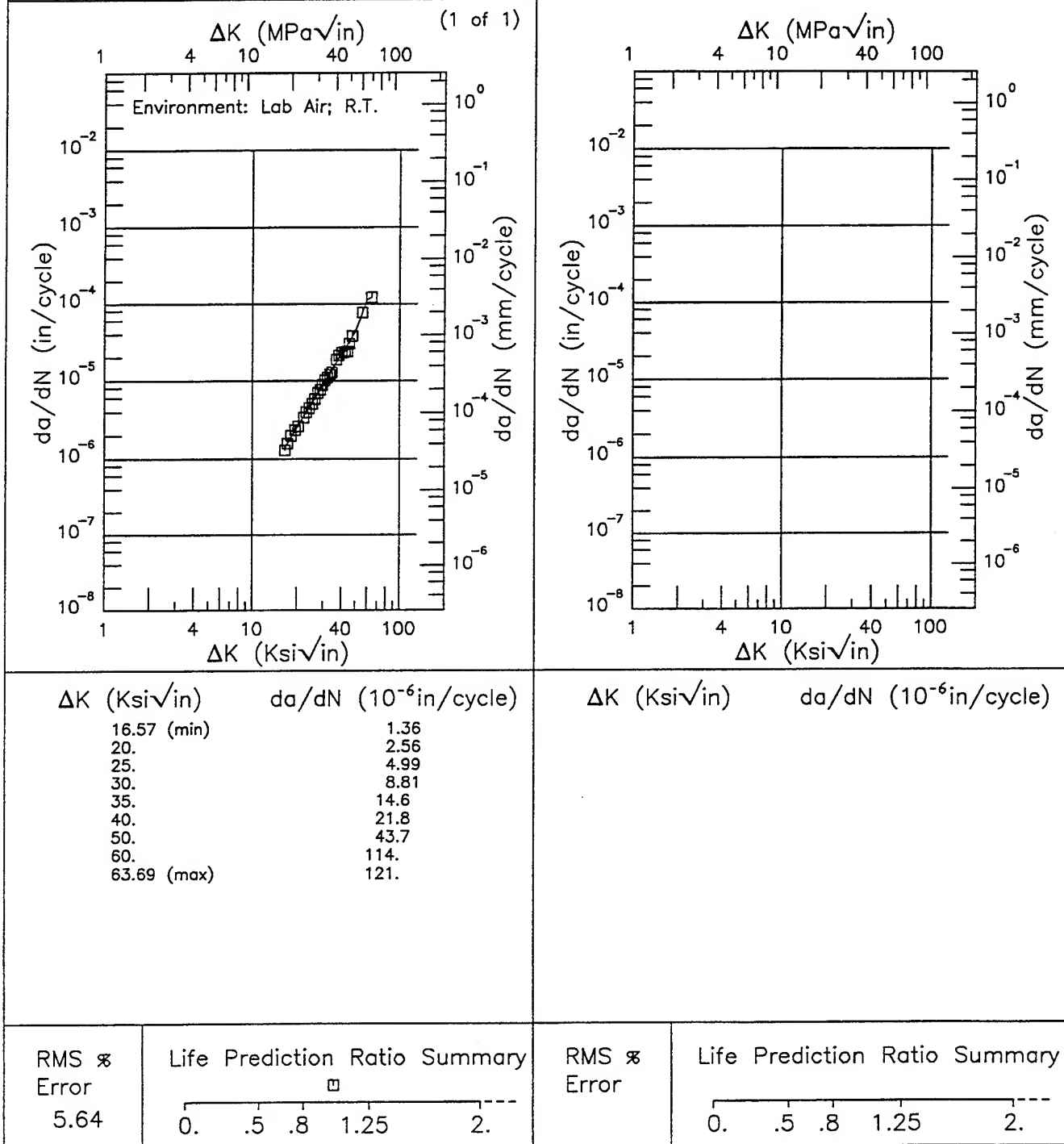
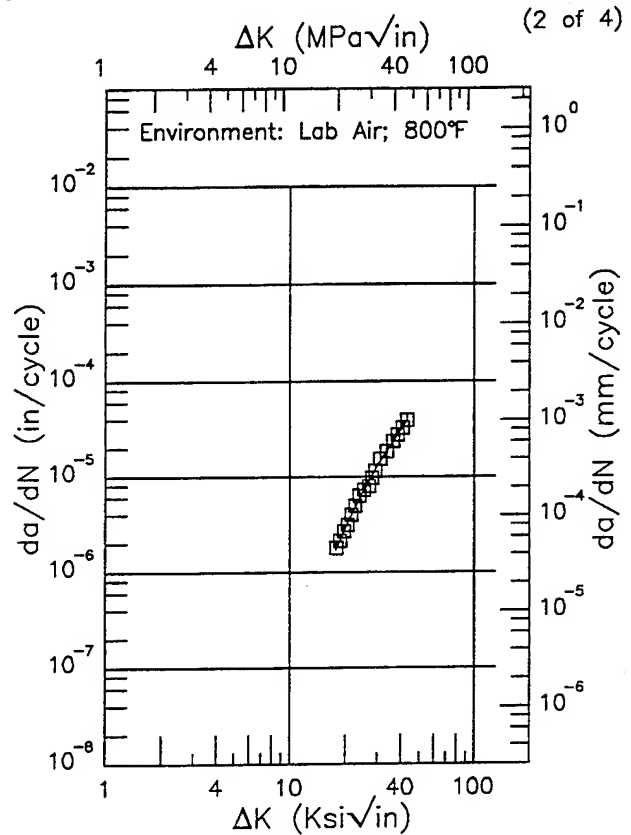
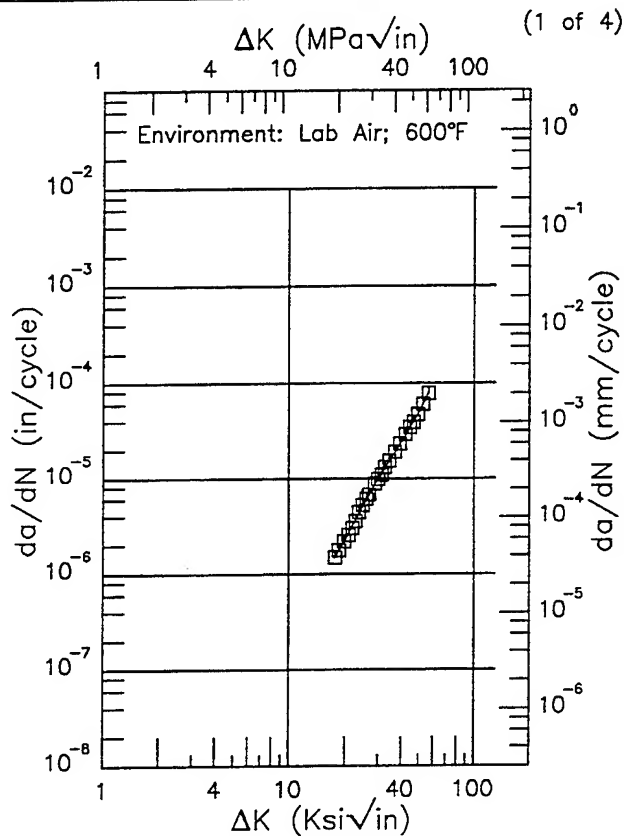


Figure 5.9.3.1.21

# INCONEL 718

Condition/Ht: 1750F AC 1325F  
 Form: 2 in. Forged Bar  
 Specimen Type: CT  
 Orientation: C-R  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 152.1 ksi  
 Ult. Strength: 194.4 ksi  
 Specimen Thk: 0.303 - 0.304 in.  
 Specimen Width: 1.478 - 1.481 in.  
 Ref: HD017



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
17.61 (min)	1.47
20.	2.26
25.	5.30
30.	10.0
35.	16.0
40.	24.2
50.	49.4
56.32 (max)	78.5

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
17.80 (min)	1.72
20.	2.88
25.	6.91
30.	12.9
35.	21.0
40.	31.2
42.93 (max)	38.3

RMS %  
 Error  
 2.02

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

RMS %  
 Error  
 4.92

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

Figure 5.9.3.1.22

Condition/Ht: 1750F AC 1325F  
 Form: 2 in. Forged Bar  
 Specimen Type: CT  
 Orientation: C-R  
 Stress Ratio: 0.05  
 Frequency: 0.7 Hz

Yield Strength: 152.1 ksi  
 Ult. Strength: 194.4 ksi  
 Specimen Thk: 0.303 - 0.304 in.  
 Specimen Width: 1.478 - 1.481 in.  
 Ref: HD017

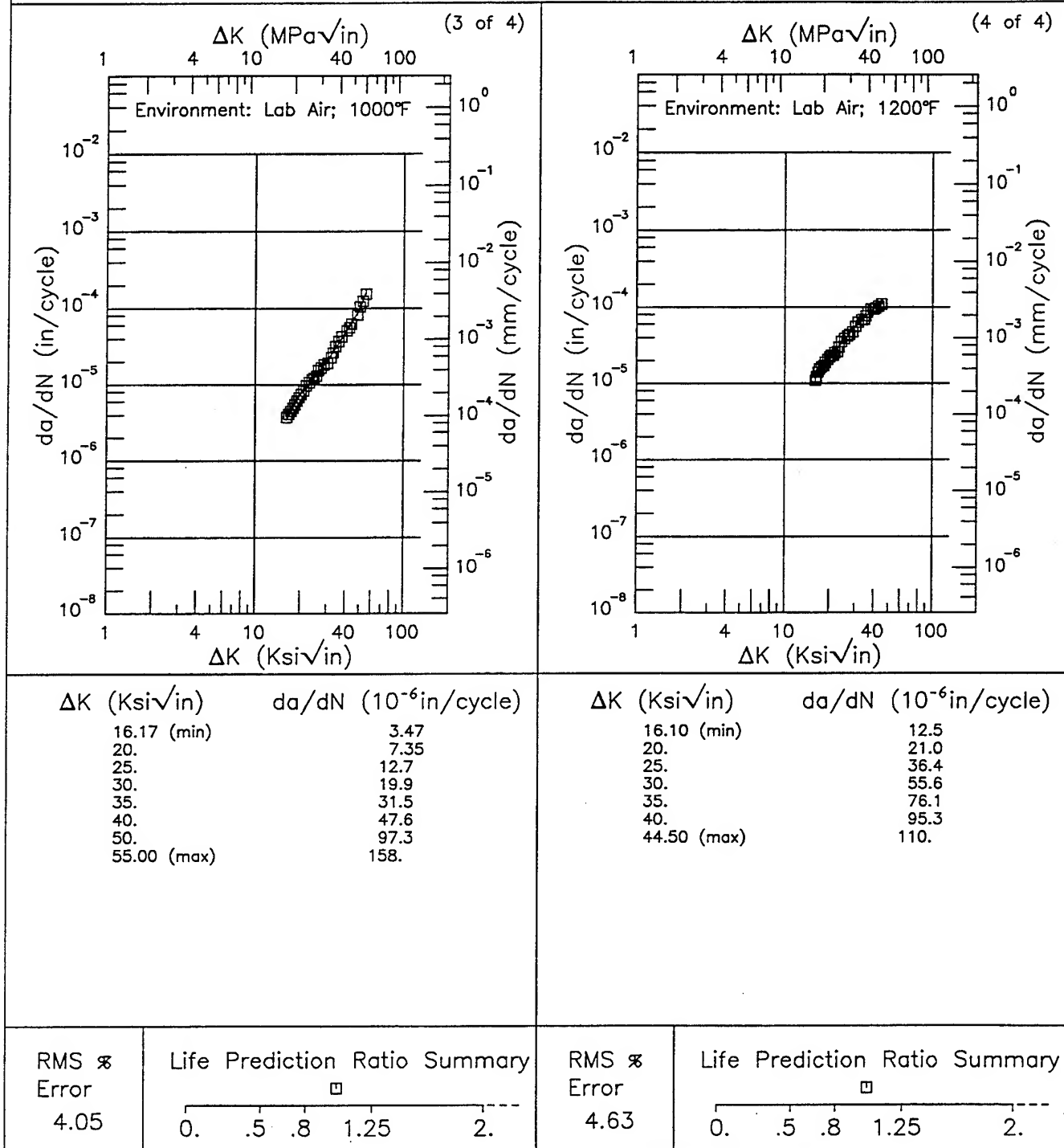


Figure 5.9.3.1.22 (Concluded)

# E INCONEL 718

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 - 1.3 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: -0.33  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.251 - 0.255 in.  
 Specimen Width: 0.903 - 0.911 in.  
 Ref: GE005

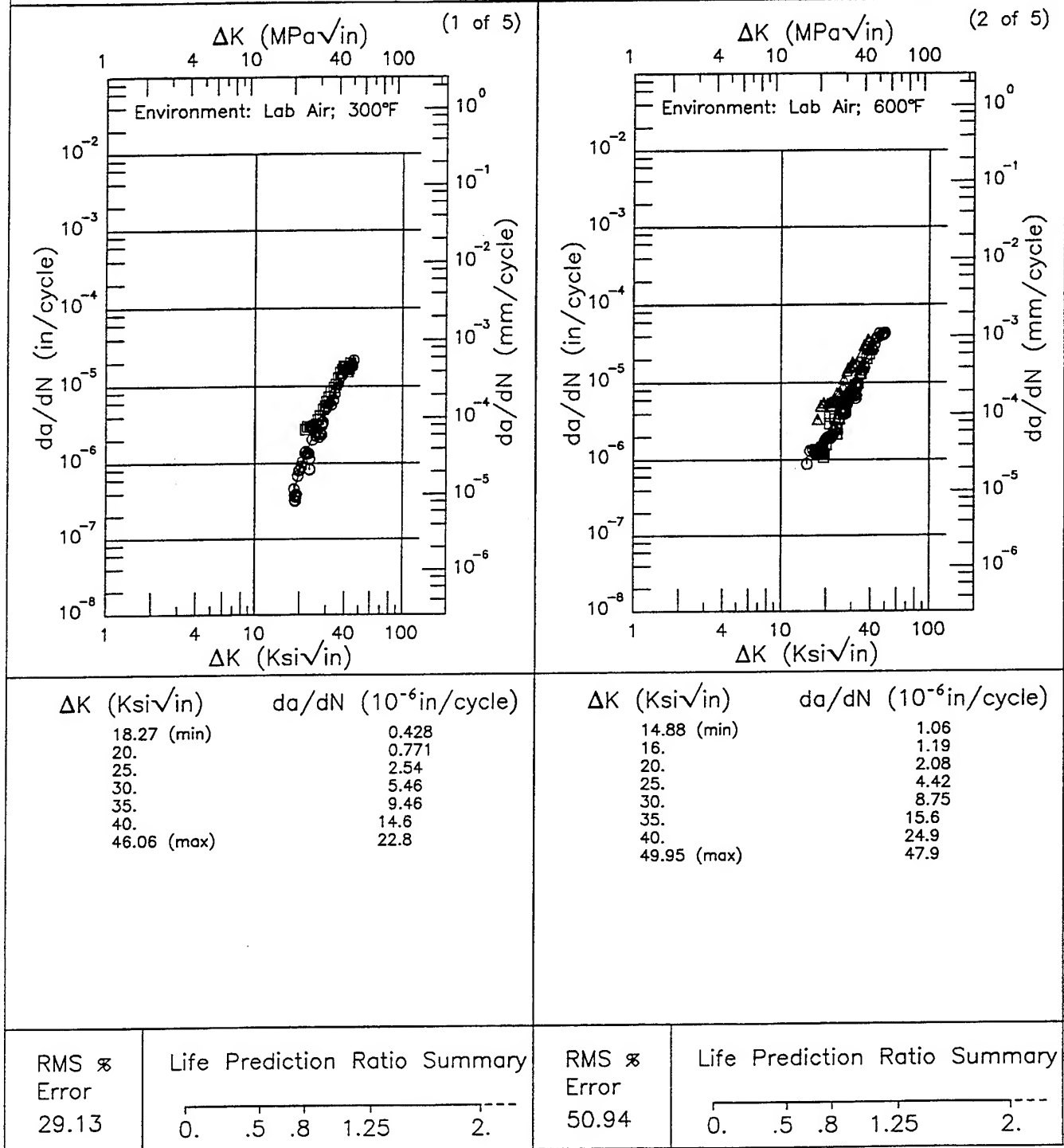
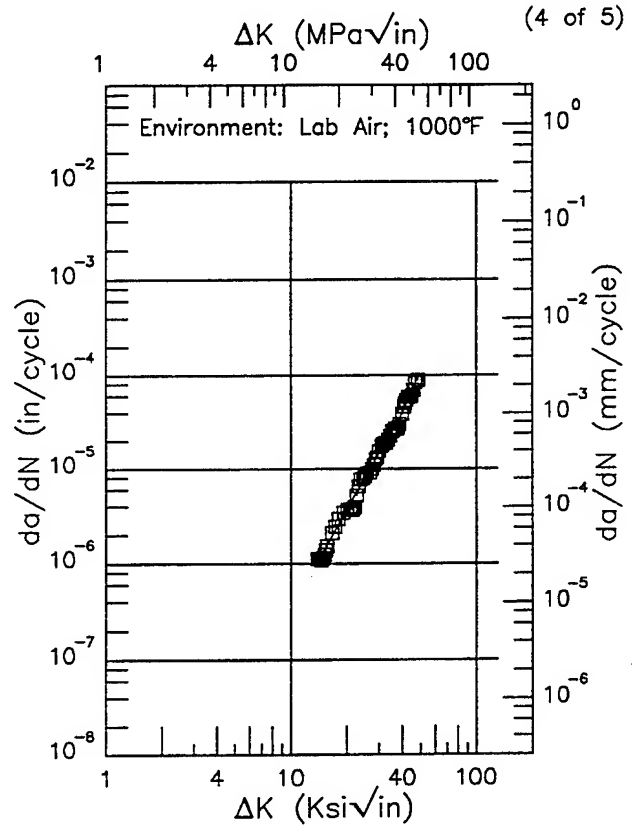
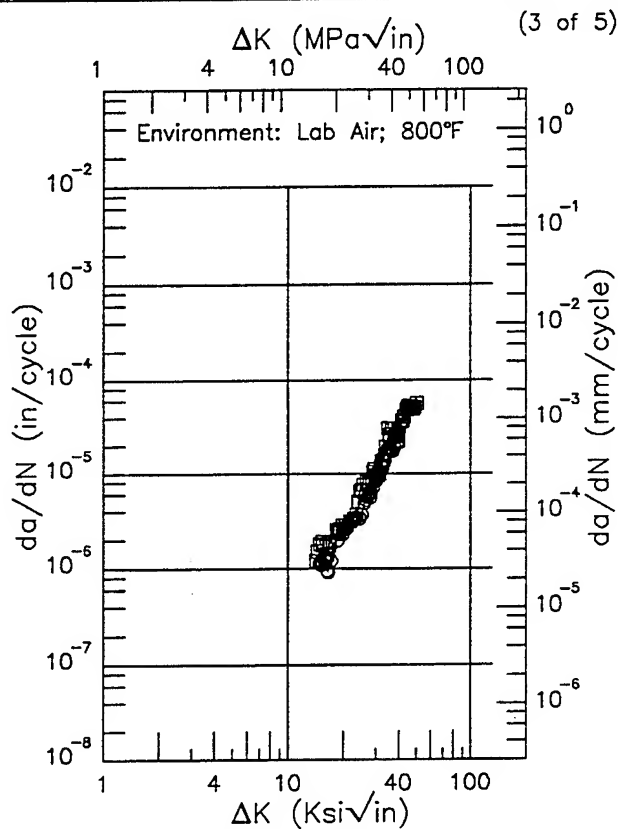


Figure 5.9.3.1.23

# INCONEL 718

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 - 1.3 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: -0.33  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.251 - 0.255 in.  
 Specimen Width: 0.903 - 0.911 in.  
 Ref: GE005



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
14.17 (min)	1.20
16.	1.42
20.	2.42
25.	5.00
30.	9.86
35.	17.9
40.	29.7
50.	64.2
50.02 (max)	64.3

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
13.89 (min)	0.986
16.	1.67
20.	3.67
25.	7.83
30.	14.4
35.	24.4
40.	40.0
48.37 (max)	92.9

RMS %  
Error  
19.18

Life Prediction Ratio Summary

RMS %  
Error  
9.74

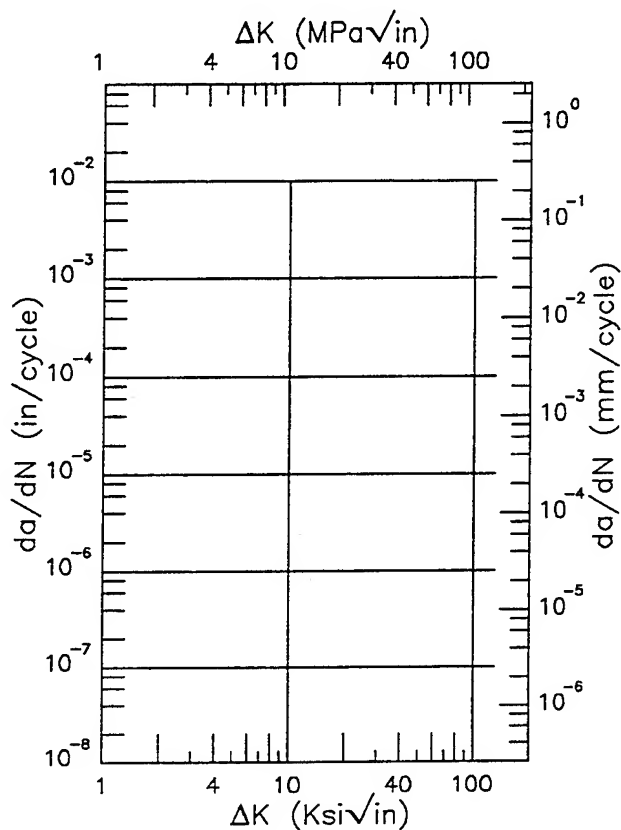
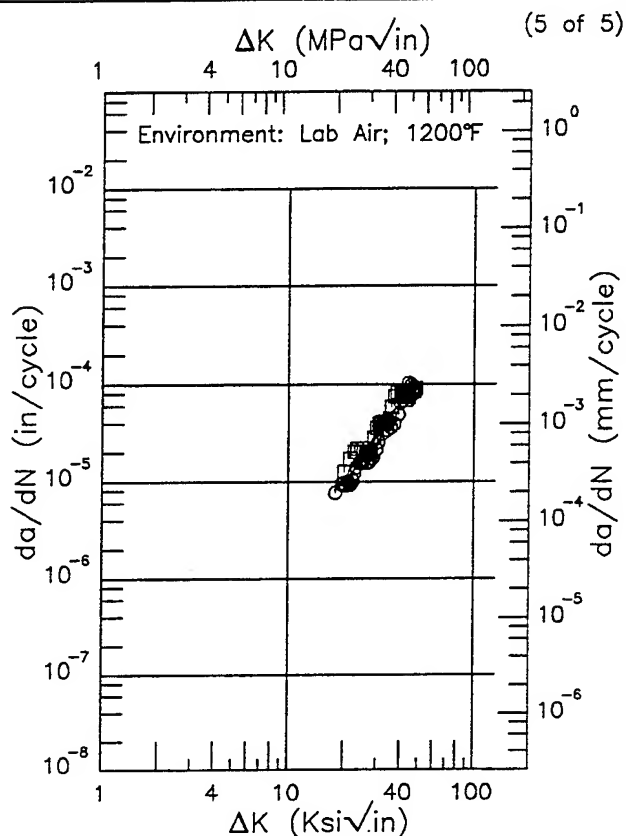
Life Prediction Ratio Summary

Figure 5.9.3.1.23 (Continued)

# INCONEL 718

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 - 1.3 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: -0.33  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.251 - 0.255 in.  
 Specimen Width: 0.903 - 0.911 in.  
 Ref: GE005



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
17.86 (min)	8.13
20.	9.75
25.	16.8
30.	28.8
35.	45.6
40.	65.4
48.27 (max)	95.9

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS  $\%$   
 Error  
 19.95

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS  $\%$   
 Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 5.9.3.1.23 (Concluded)

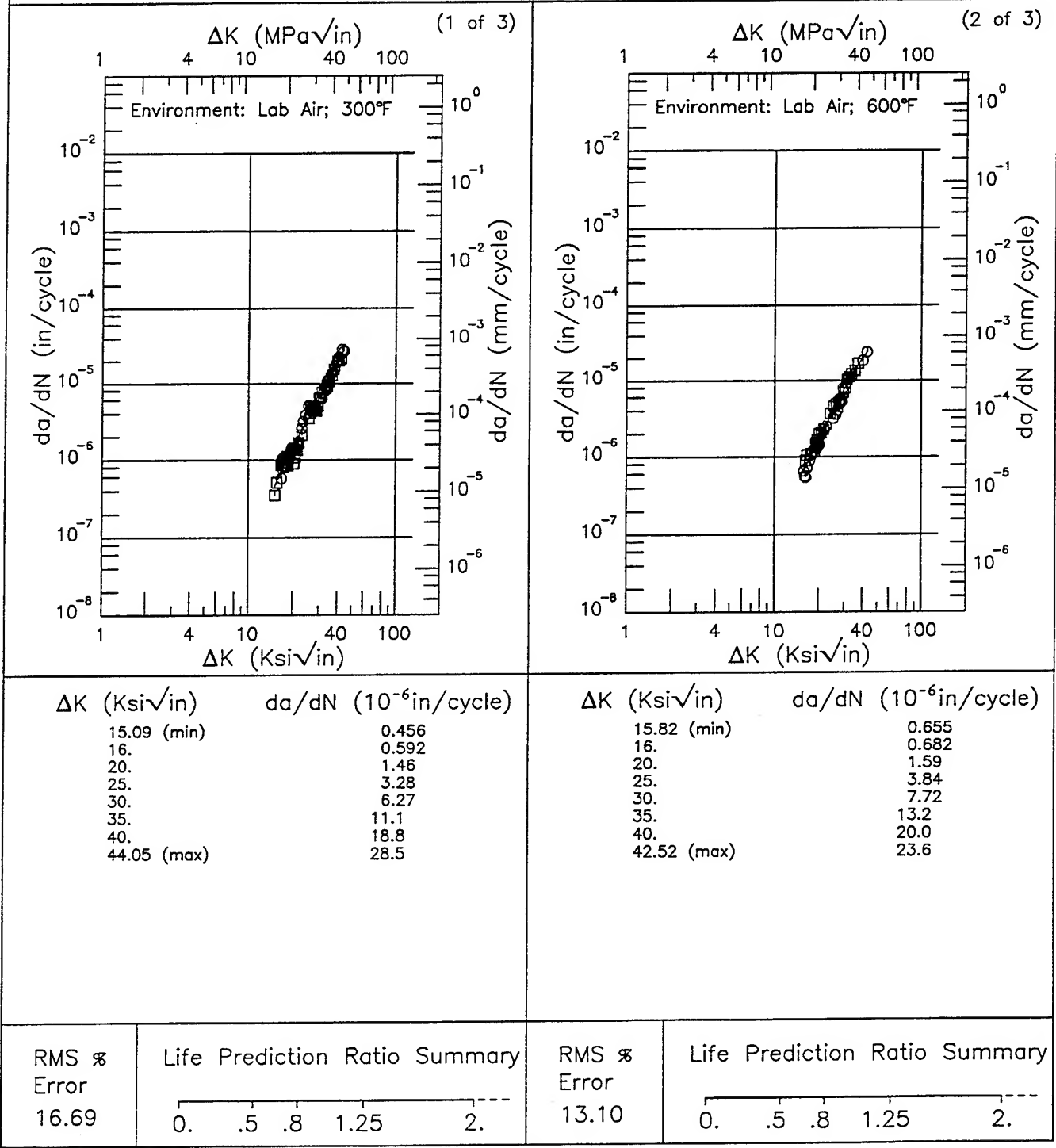


**This page intentionally left blank**

# E | INCONEL 718 |

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: 0.  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.252 in.  
 Specimen Width: 0.9 - 0.906 in.  
 Ref: GE005



**Figure 5.9.3.1.24**  
 5-120

# INCONEL 718

E

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: 0.  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.252 in.  
 Specimen Width: 0.9 - 0.906 in.  
 Ref: GE005

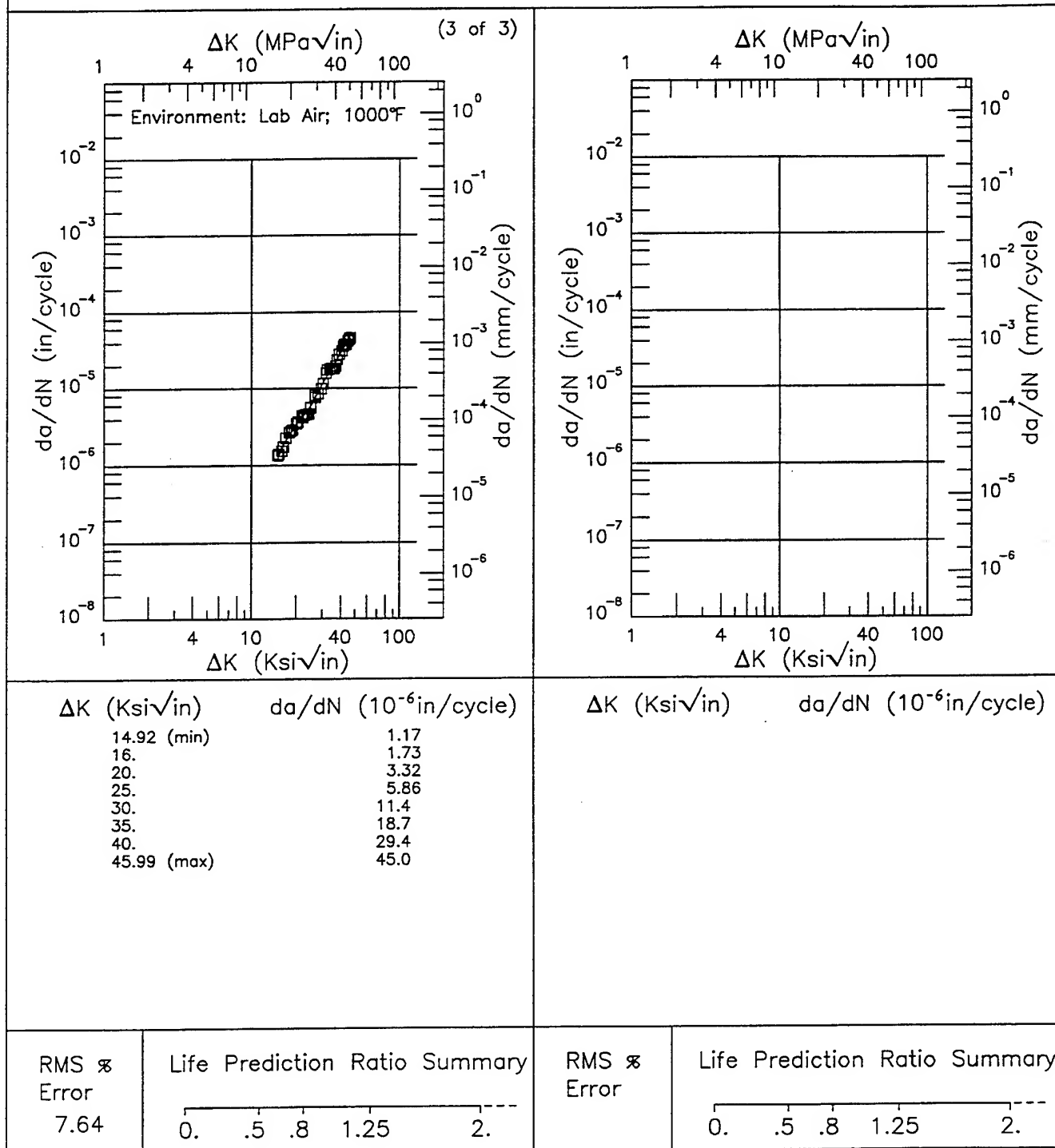


Figure 5.9.3.1.24 (Concluded)

# E INCONEL 718

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 - 1.3 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: 0.03  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.254 in.  
 Specimen Width: 0.9 - 0.91 in.  
 Ref: GE005

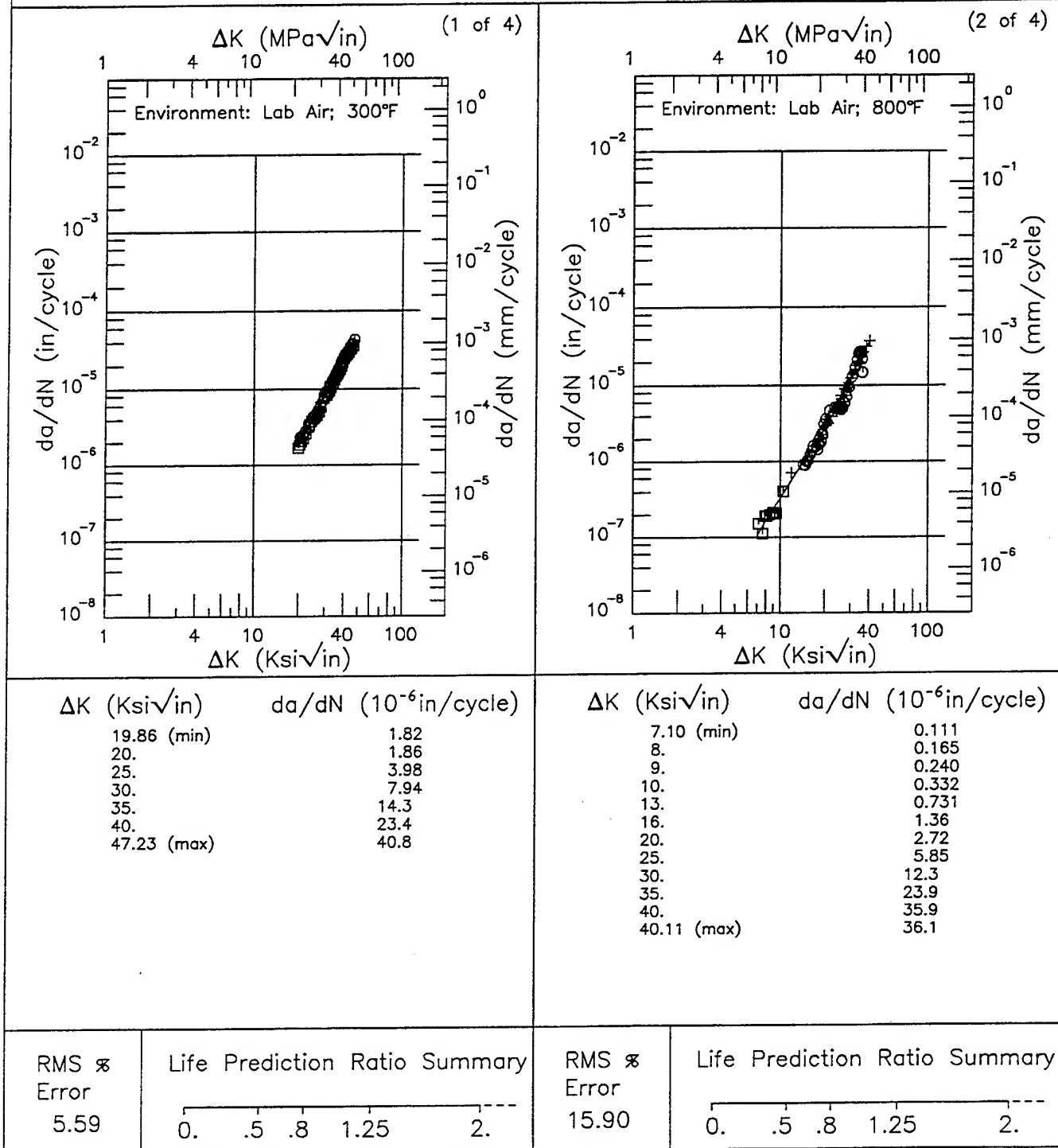


Figure 5.9.3.1.25

# INCONEL 718

E

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 - 1.3 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: 0.03  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.254 in.  
 Specimen Width: 0.9 - 0.91 in.  
 Ref: GE005

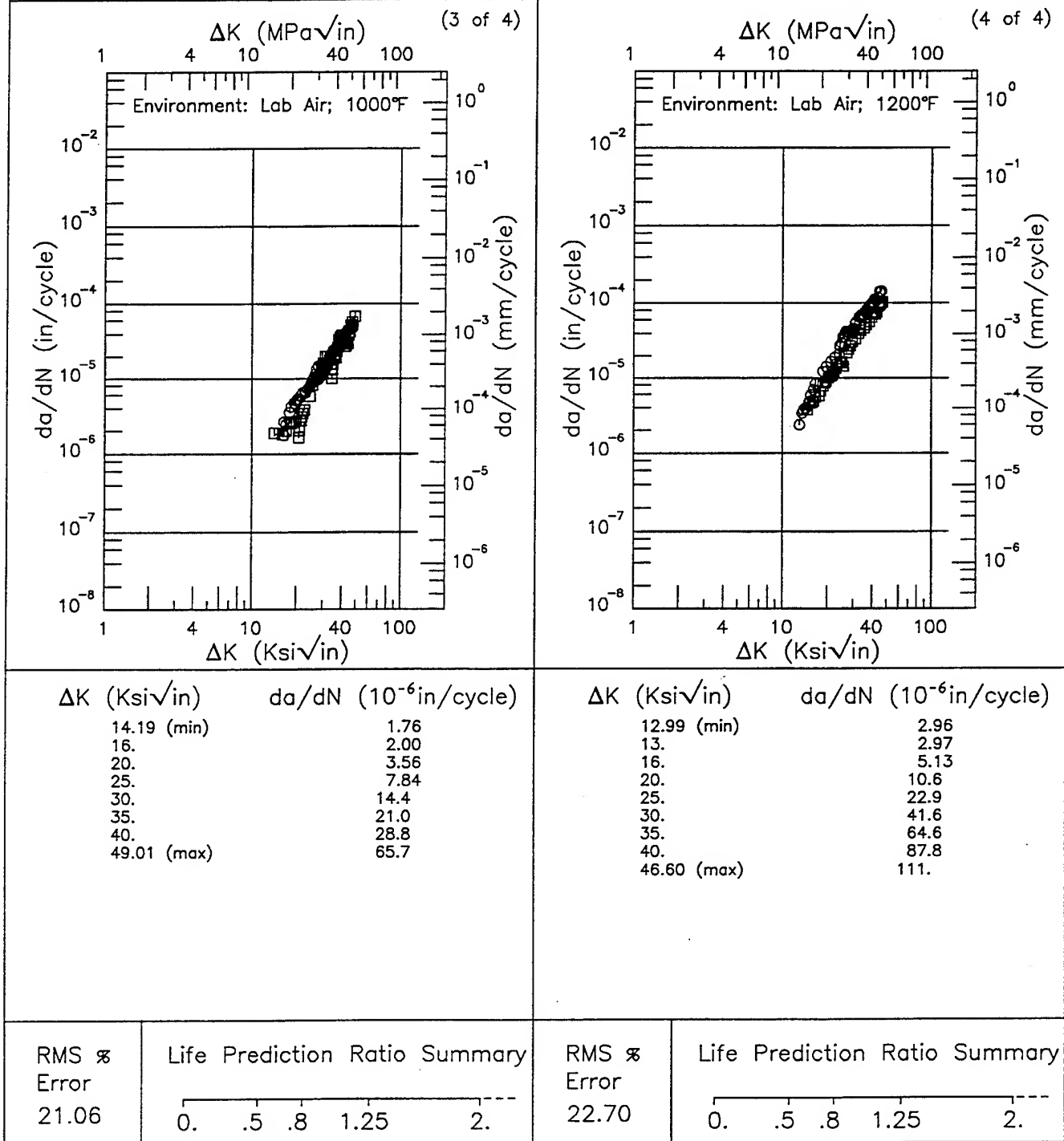
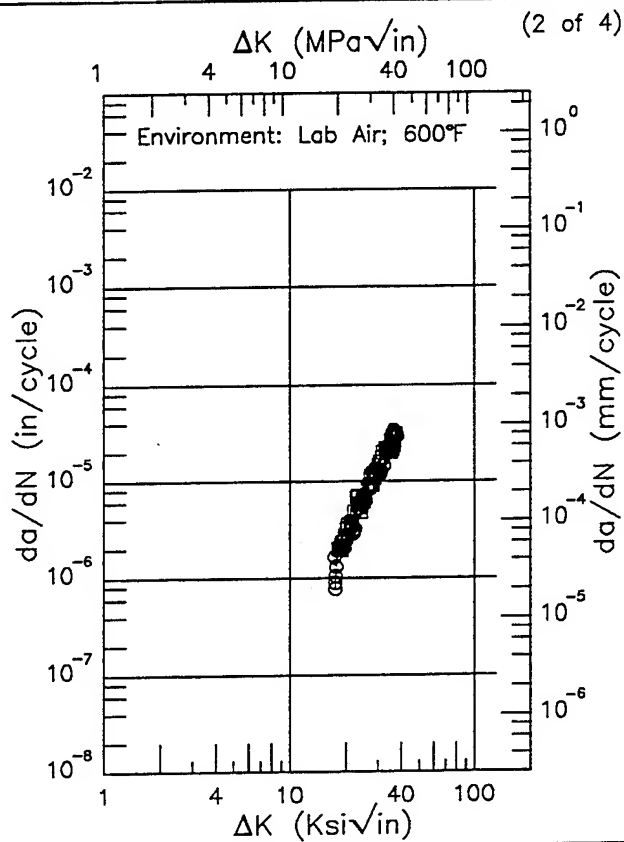
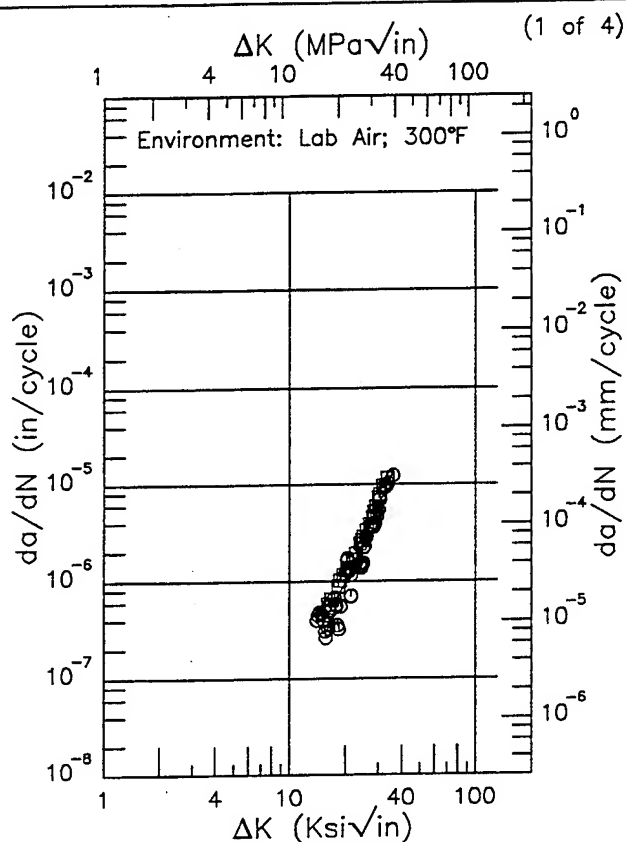


Figure 5.9.3.1.25 (Concluded)

# INCONEL 718

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 - 1.3 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: 0.25  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.253 in.  
 Specimen Width: 0.9 - 0.909 in.  
 Ref: GE005

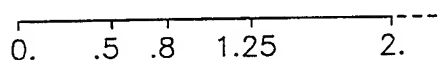


$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
13.99 (min)	0.373
16.	0.465
20.	0.949
25.	2.53
30.	6.03
35.	12.1
35.84 (max)	13.4

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
17.33 (min)	1.36
20.	2.67
25.	6.83
30.	13.8
35.	24.3
38.01 (max)	32.8

RMS %  
Error  
23.83

Life Prediction Ratio Summary



RMS %  
Error  
16.68

Life Prediction Ratio Summary

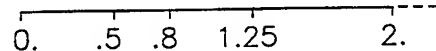


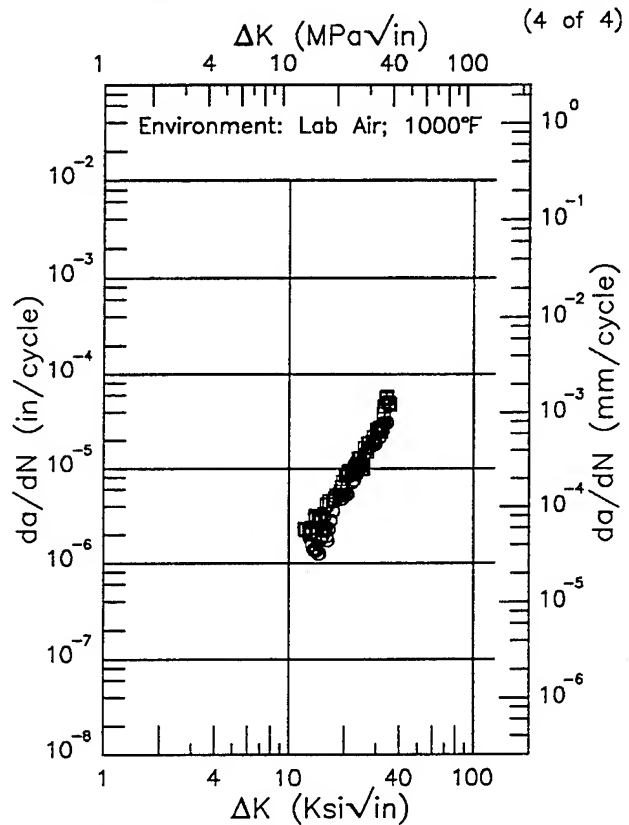
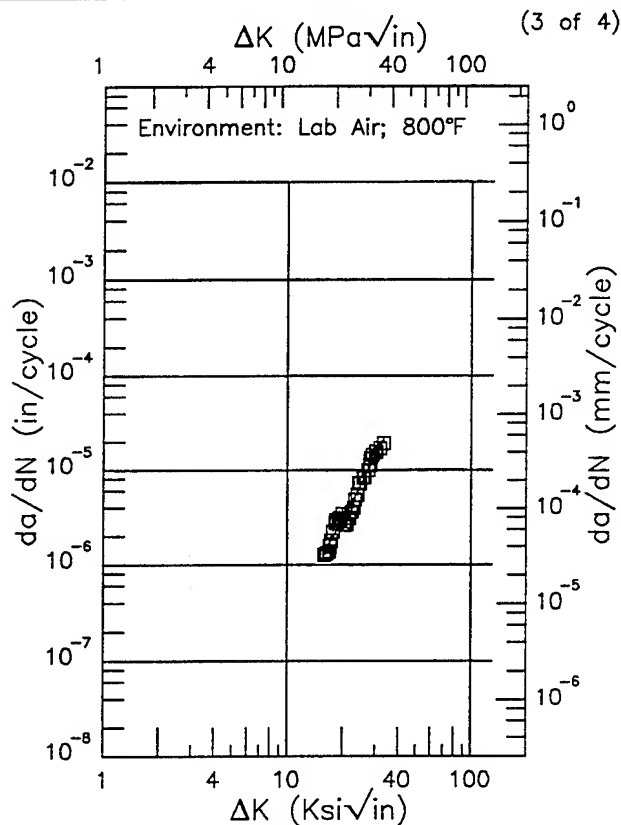
Figure 5.9.3.1.26

# INCONEL 718

E

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 - 1.3 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: 0.25  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.253 in.  
 Specimen Width: 0.9 - 0.909 in.  
 Ref: GE005



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
15.78 (min)	1.36
16.	1.41
20.	2.91
25.	6.95
30.	14.4
33.30 (max)	21.3

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
12.17 (min)	1.63
13.	1.80
16.	2.89
20.	5.80
25.	13.0
30.	25.5
35.	43.8
35.35 (max)	45.3

RMS %  
Error  
15.48

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2. ---

RMS %  
Error  
22.77

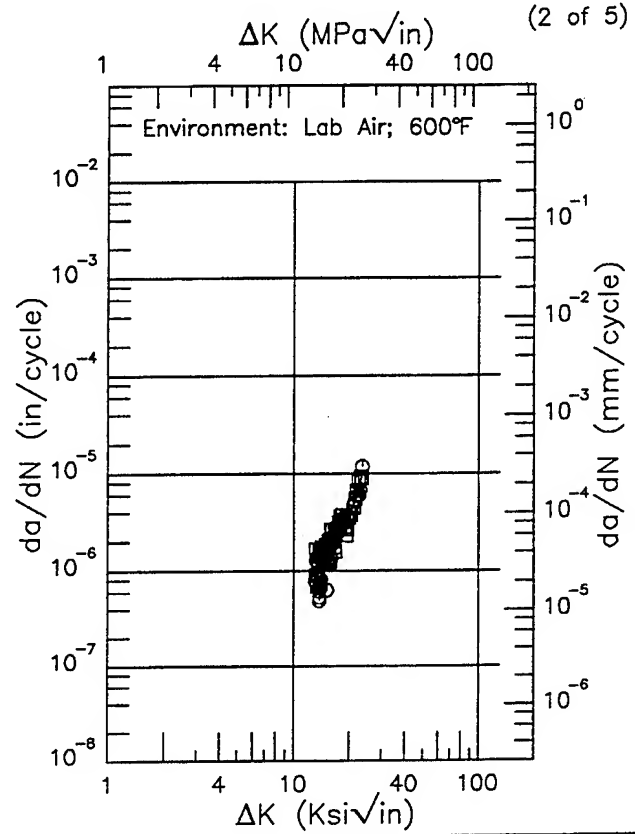
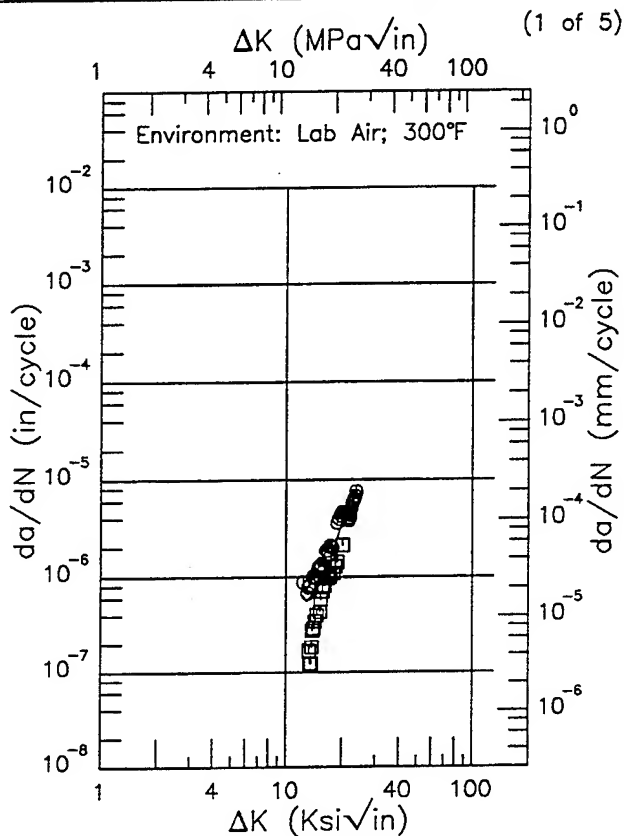
Life Prediction Ratio Summary  
 0. .5 .8 1.25 2. ---

Figure 5.9.3.1.26 (Concluded)

# INCONEL 718

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 - 1.3 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: 0.54  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.255 in.  
 Specimen Width: 0.902 - 0.922 in.  
 Ref: GE005



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.37 (min)	0.643
13.	0.555
16.	0.934
20.	3.59
23.59 (max)	5.83

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.93 (min)	1.08
13.	1.07
16.	1.97
20.	3.63
23.39 (max)	9.65

RMS %  
 Error  
 41.56

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
 Error  
 23.62

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 5.9.3.1.27



# INCONEL 718

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 - 1.3 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: 0.54  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi

Ult. Strength:

Specimen Thk: 0.25 - 0.255 in.

Specimen Width: 0.902 - 0.922 in.

Ref: GE005

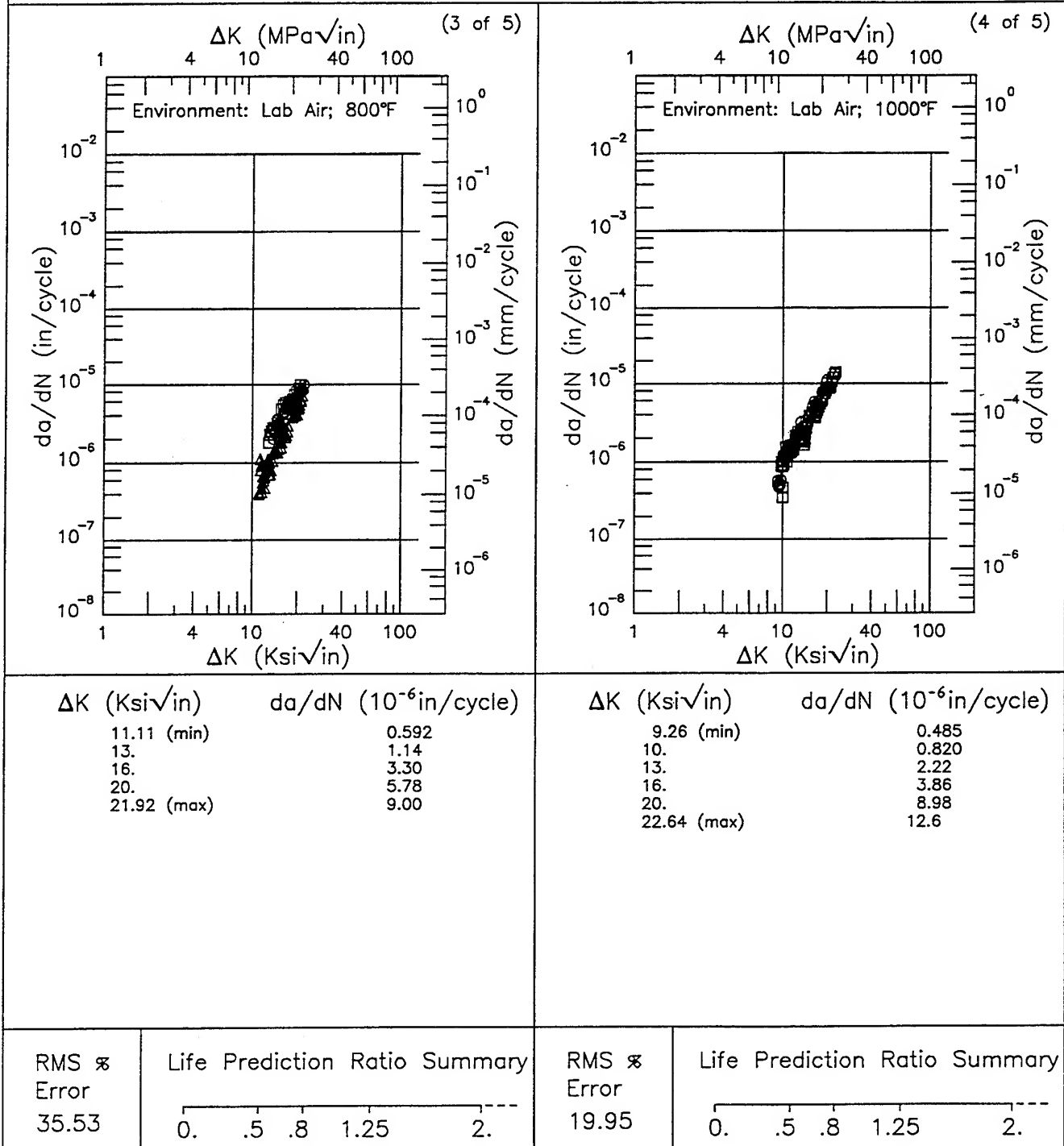


Figure 5.9.3.127 (Continued)

# E INCONEL 718

Condition/Ht: 1750F 1HR Q 1325F 8HR FC TO 1150F AT 100F/HR HOLD 8HR  
 Form: 1.13 - 1.3 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: 0.54  
 Frequency: 0.3 Hz

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.255 in.  
 Specimen Width: 0.902 - 0.922 in.  
 Ref: GE005

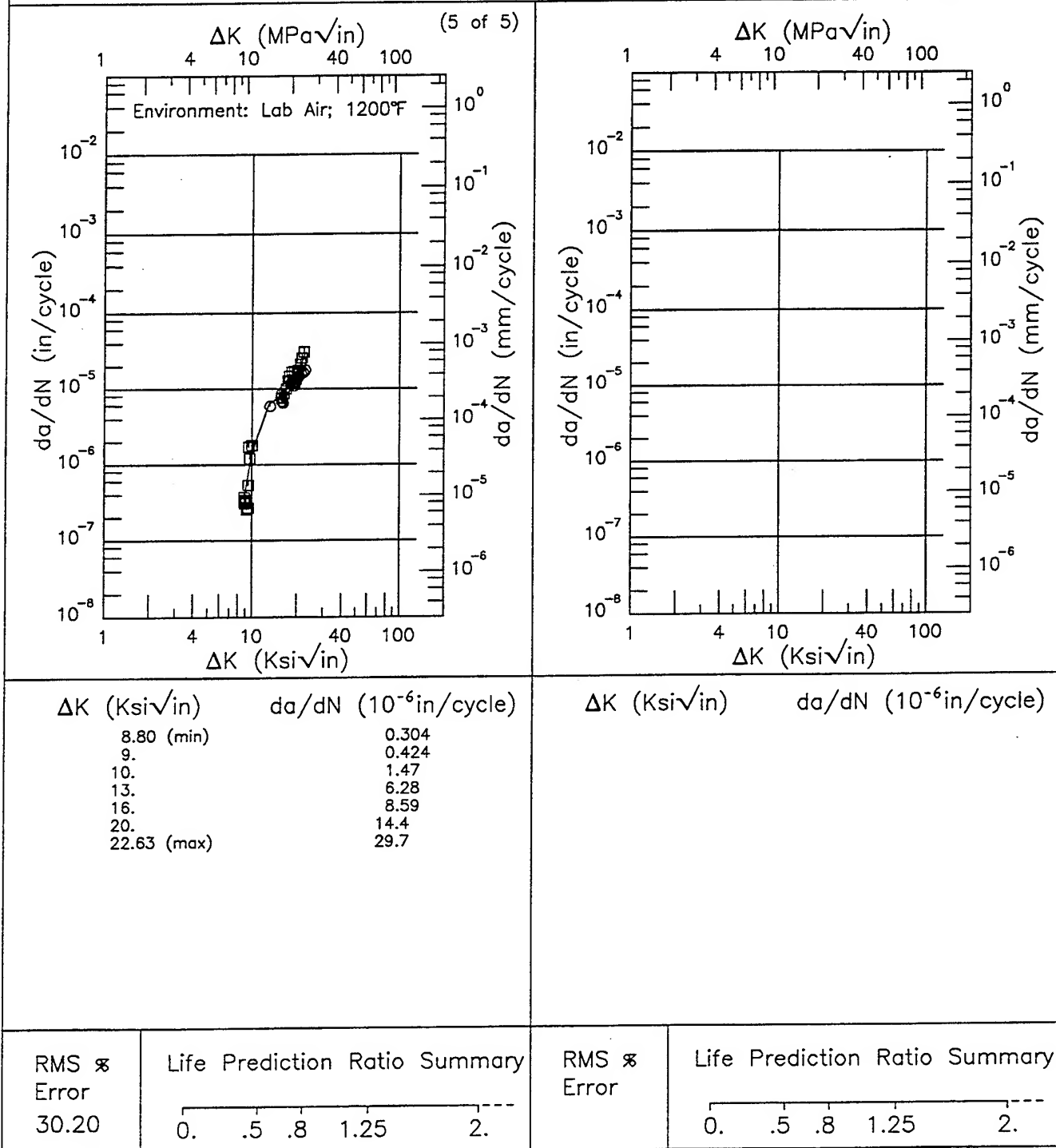


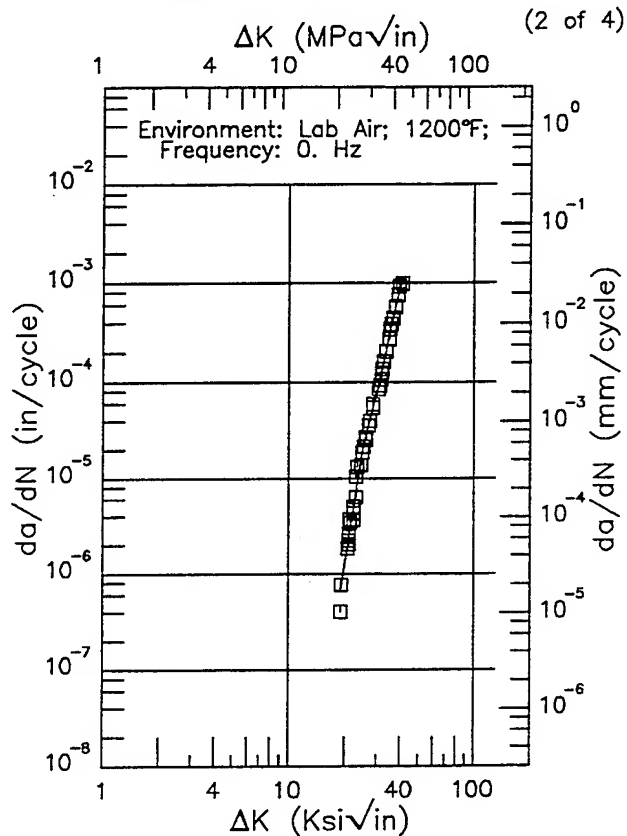
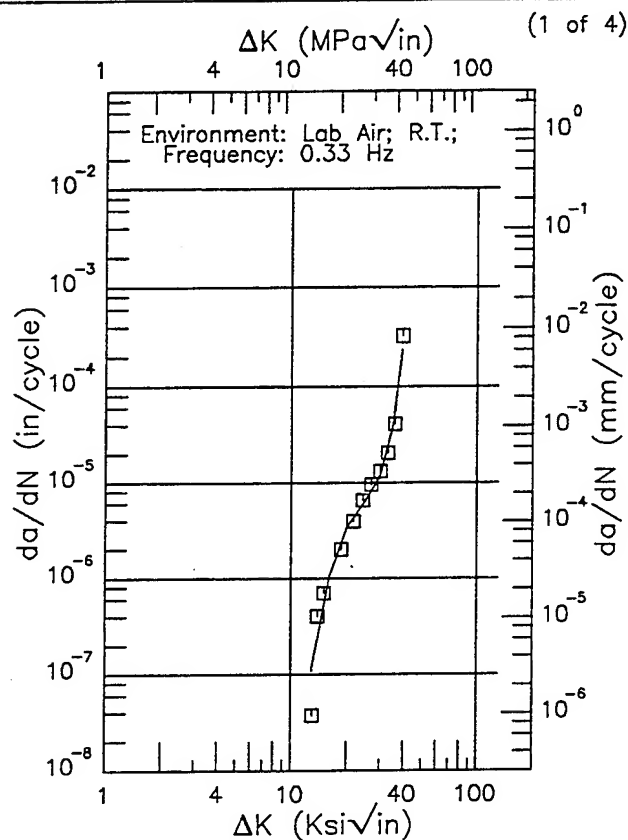
Figure 5.9.3.1.27 (Concluded)

**This page intentionally left blank**

# INCONEL 718

Condition/Ht: 1760F 1HR WQ 1325F 8HRS  
 Form: 3.6 in. Disk  
 Specimen Type: CCP (max stress specified)  
 Orientation: C-R  
 Stress Ratio: 0.

Yield Strength: 171.6 ksi  
 Ult. Strength: 201.7 ksi  
 Specimen Thk: 0.08 in.  
 Specimen Width: 2 in.  
 Ref: GE008



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.93 (min)	0.108
13.	0.116
16.	1.01
20.	3.39
25.	6.49
30.	11.9
35.	41.2
39.18 (max)	236.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
19.03 (min)	0.685
20.	1.21
25.	20.1
30.	80.0
35.	311.
40.	916.
41.00 (max)	1009.

RMS  $\%$   
 Error  
 38.40

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2.

RMS  $\%$   
 Error  
 18.18

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2.

Figure 5.9.3.1.28

Condition/Ht: 1760F 1HR WQ 1325F 8HRS  
 Form: 3.6 in. Disk  
 Specimen Type: CCP (max stress specified)  
 Orientation: C-R  
 Stress Ratio: 0.

Yield Strength: 171.6 ksi  
 Ult. Strength: 201.7 ksi  
 Specimen Thk: 0.08 in.  
 Specimen Width: 2 in.  
 Ref: GE008

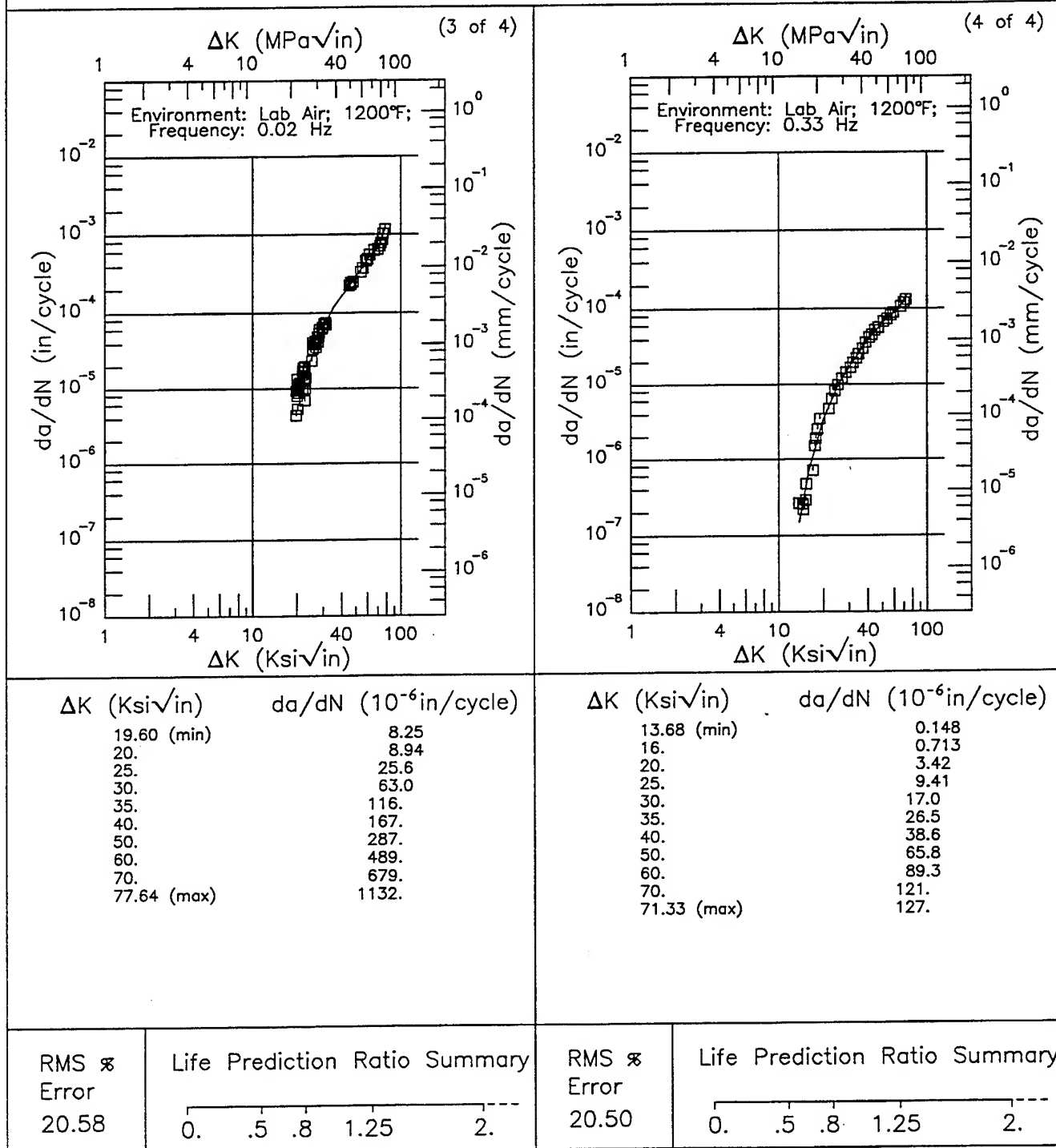
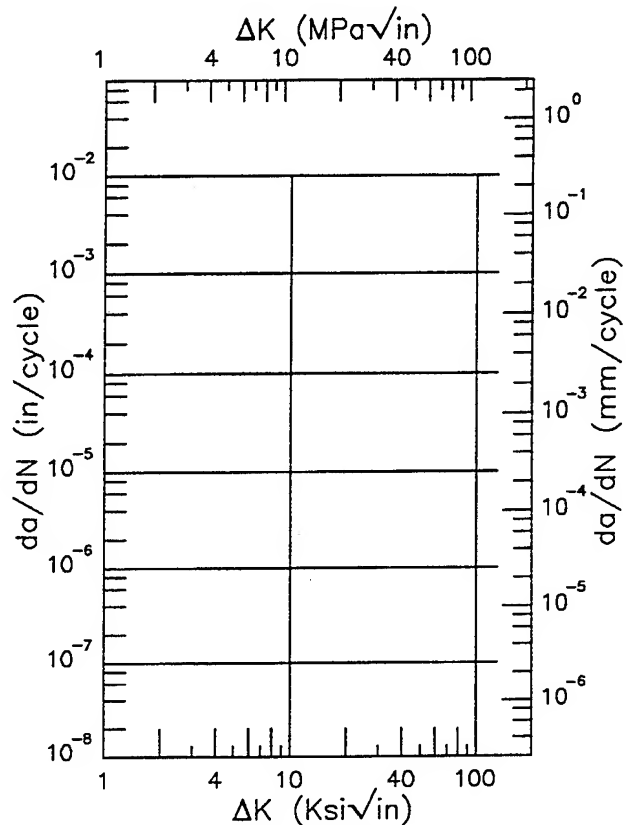
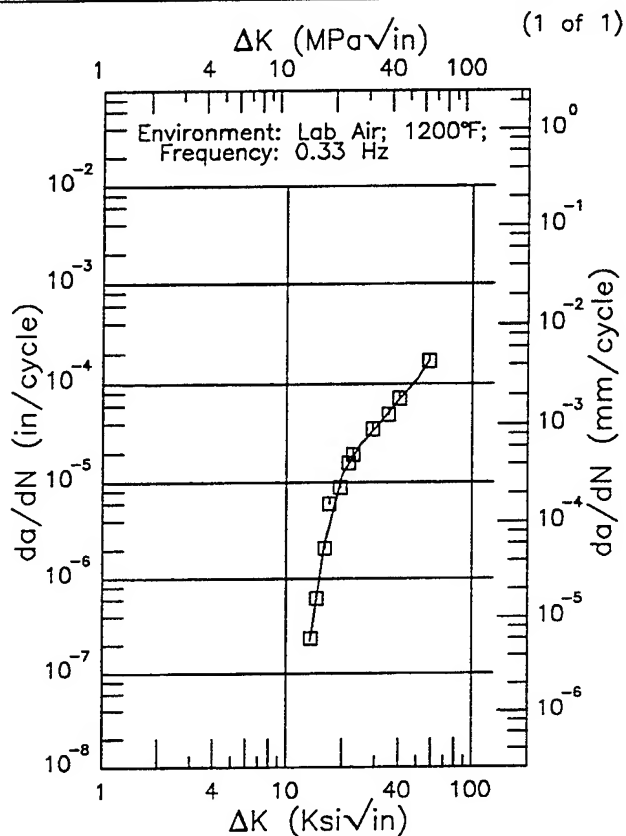


Figure 5.9.3.1.28 (Concluded)

# INCONEL 718

Condition/Ht: 1760F 1HR WQ 1325F 8HRS  
Form: 3.6 in. Disk  
Specimen Type: CCP (max stress specified)  
Orientation: C-R  
Stress Ratio: 0.

Yield Strength: 171.6 ksi  
Ult. Strength: 201.7 ksi  
Specimen Thk: 0.25 in.  
Specimen Width: 0.6 in.  
Ref: GE008



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
13.48 (min)	0.223
16.	2.30
20.	12.0
25.	24.7
30.	35.7
35.	50.6
40.	68.7
50.	109.
58.25 (max)	166.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
--------------------------------------	-------------------------------

RMS %  
Error  
20.72

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 5.9.3.1.29

Condition/Ht: 1800F 1HR Q 1325F 8HRS FC TO 1150F HOLD 8HRS AC  
 Form: 4.67 in. Forging  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Frequency: 0.3 Hz  
 Environment: LAB AIR;1200°F

Yield Strength: 169.2 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 in.  
 Specimen Width: 0.6 in.  
 Ref: GE001

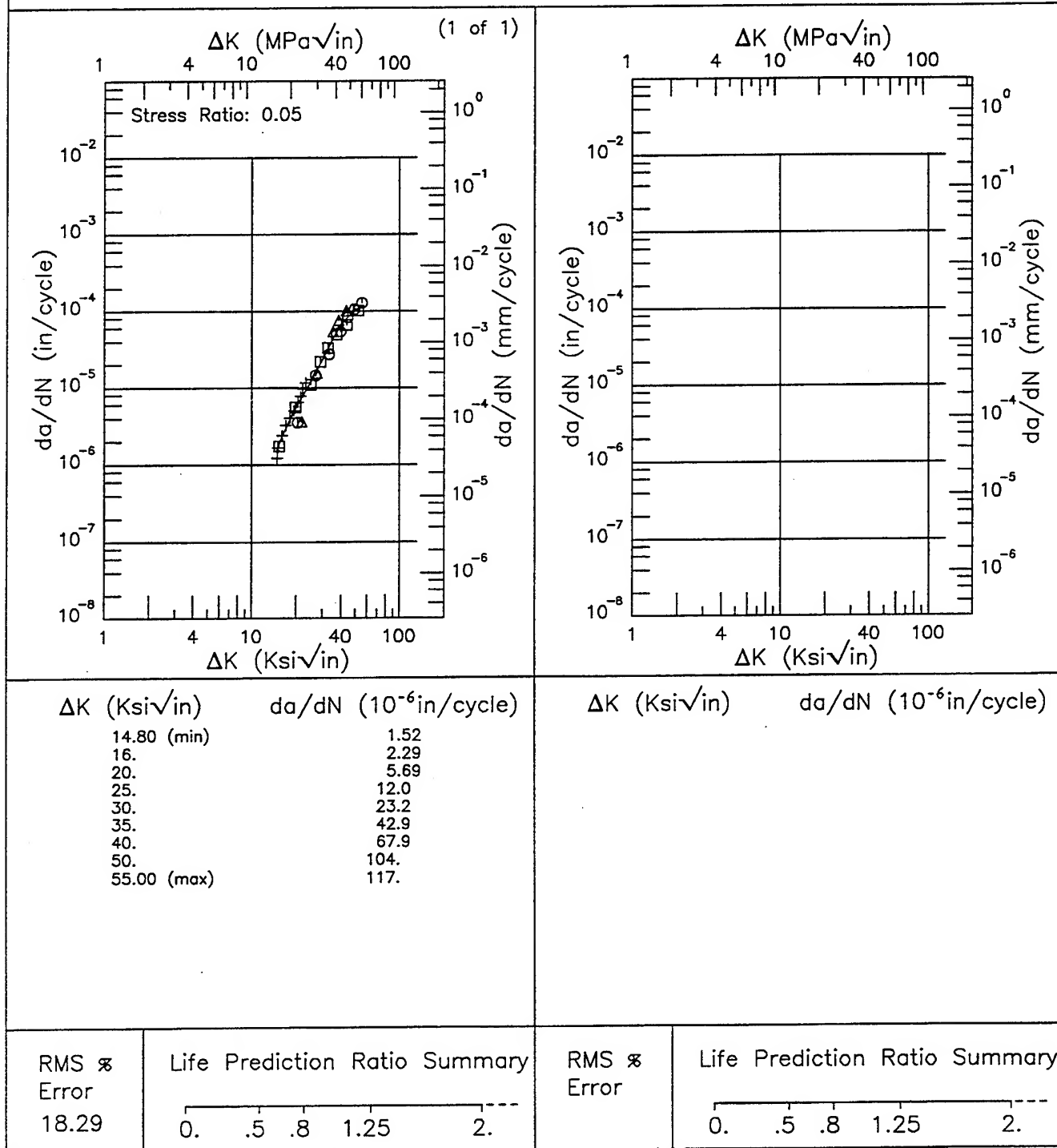


Figure 5.9.3.1.30

# EF INCONEL 718

Condition/Ht: 1950F AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.05

Yield Strength: 161.1 ksi  
 Ult. Strength: 198.2 ksi  
 Specimen Thk: 0.49 - 0.491 in.  
 Specimen Width: 1.992 - 1.997 in.  
 Ref: HD015

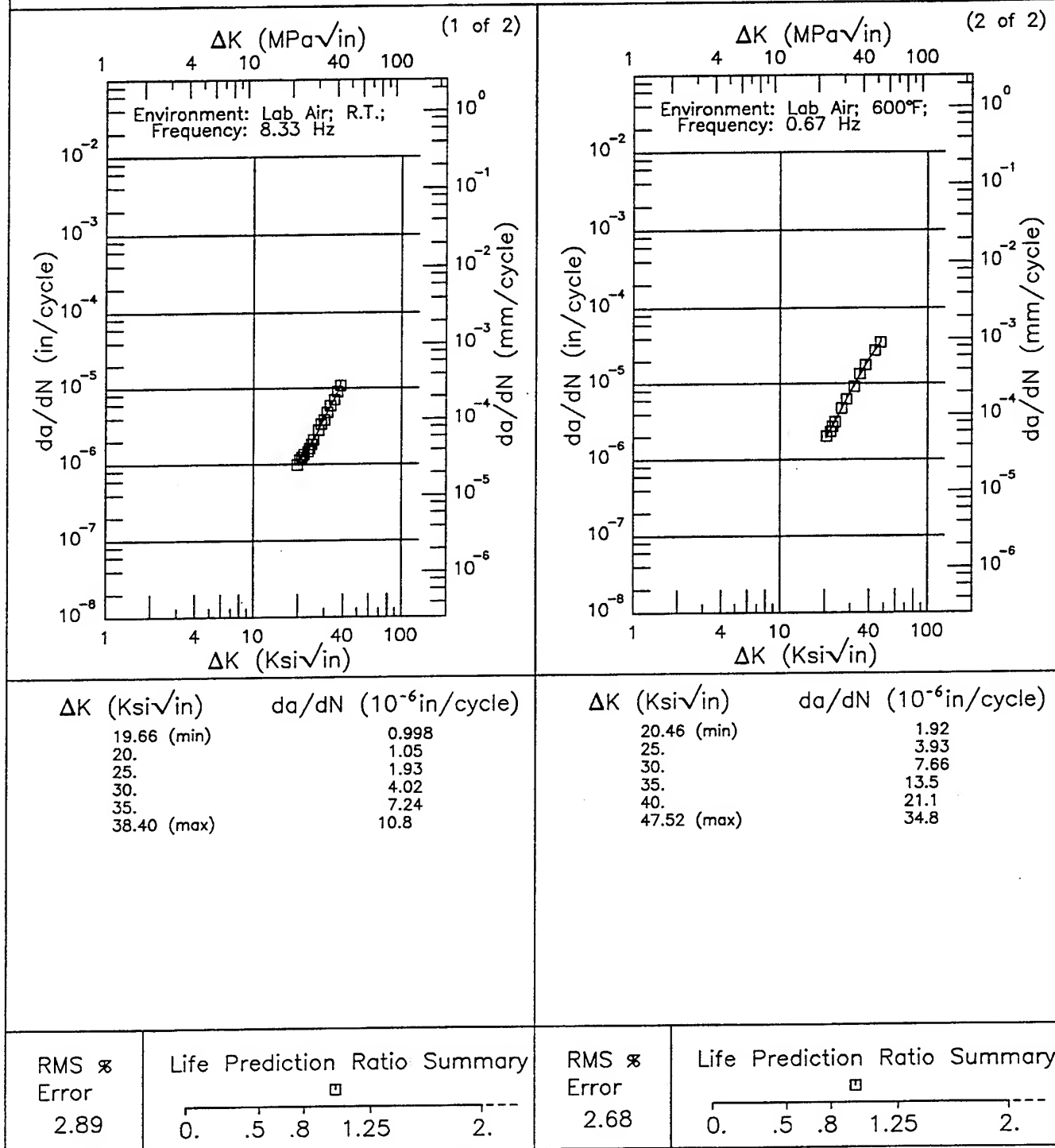


Figure 5.9.3.1.31



Condition/Ht: 1950F AC 1325F  
 Form: 0.5 in. Plate  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.05

Yield Strength: 161.1 ksi  
 Ult. Strength: 198.2 ksi  
 Specimen Thk: 0.49 in.  
 Specimen Width: 1.996 - 1.998 in.  
 Ref: HD015

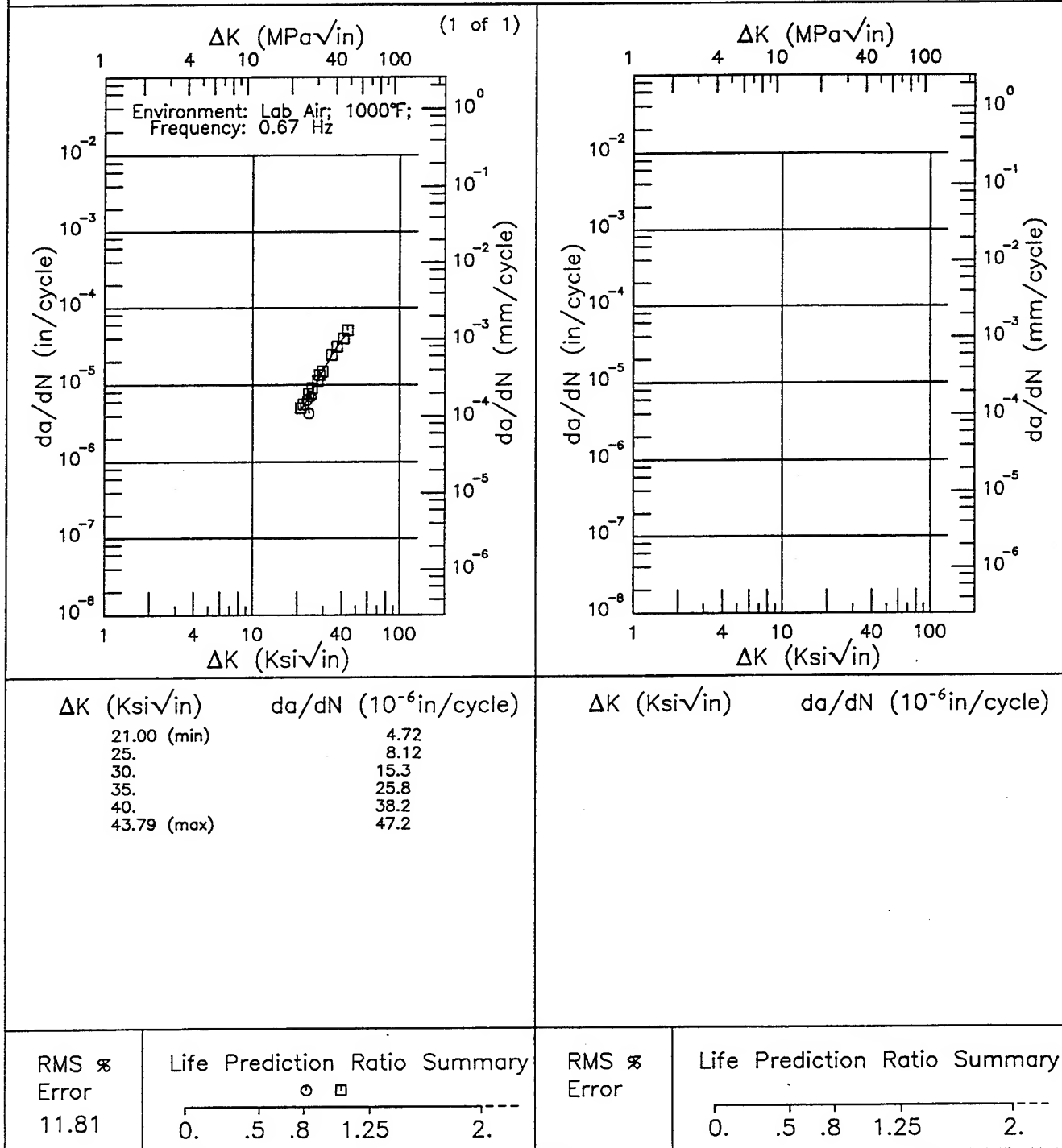


Figure 5.9.3.1.32

# R | INCONEL 718 |

Condition/Ht: ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HR  
TO 1150F, 1150F 8HR, AC

Form: 0.75 in. Plate

Specimen Type: CT

Orientation: L-T

Frequency: 20 Hz

Environment: LAB AIR; RT

Yield Strength: 180 ksi

Ult. Strength: 218 ksi

Specimen Thk: 0.187 in.

Specimen Width: 1.5 in.

Ref: MA016

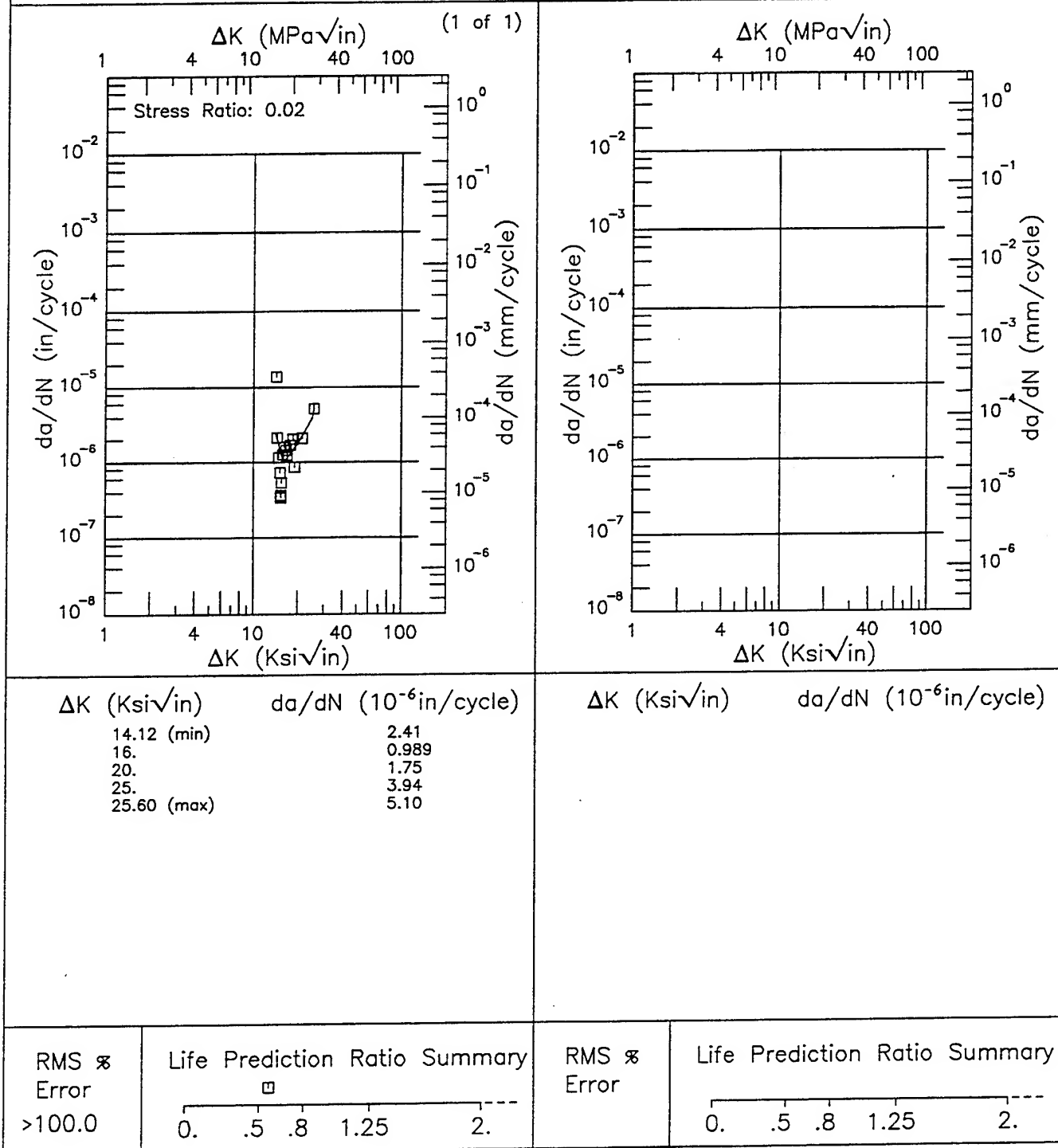


Figure 5.9.3.1.33

# INCONEL 718

R

Condition/Ht: ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HR  
TO 1150F, 1150F 8HR, AC

Form: 0.75 in. Plate

Specimen Type: CT

Orientation: L-T

Frequency: 10 Hz

Environment: VACUUM; RT

Yield Strength: 180 ksi

Ult. Strength: 218 ksi

Specimen Thk: 0.187 in.

Specimen Width: 1.5 in.

Ref: MA016

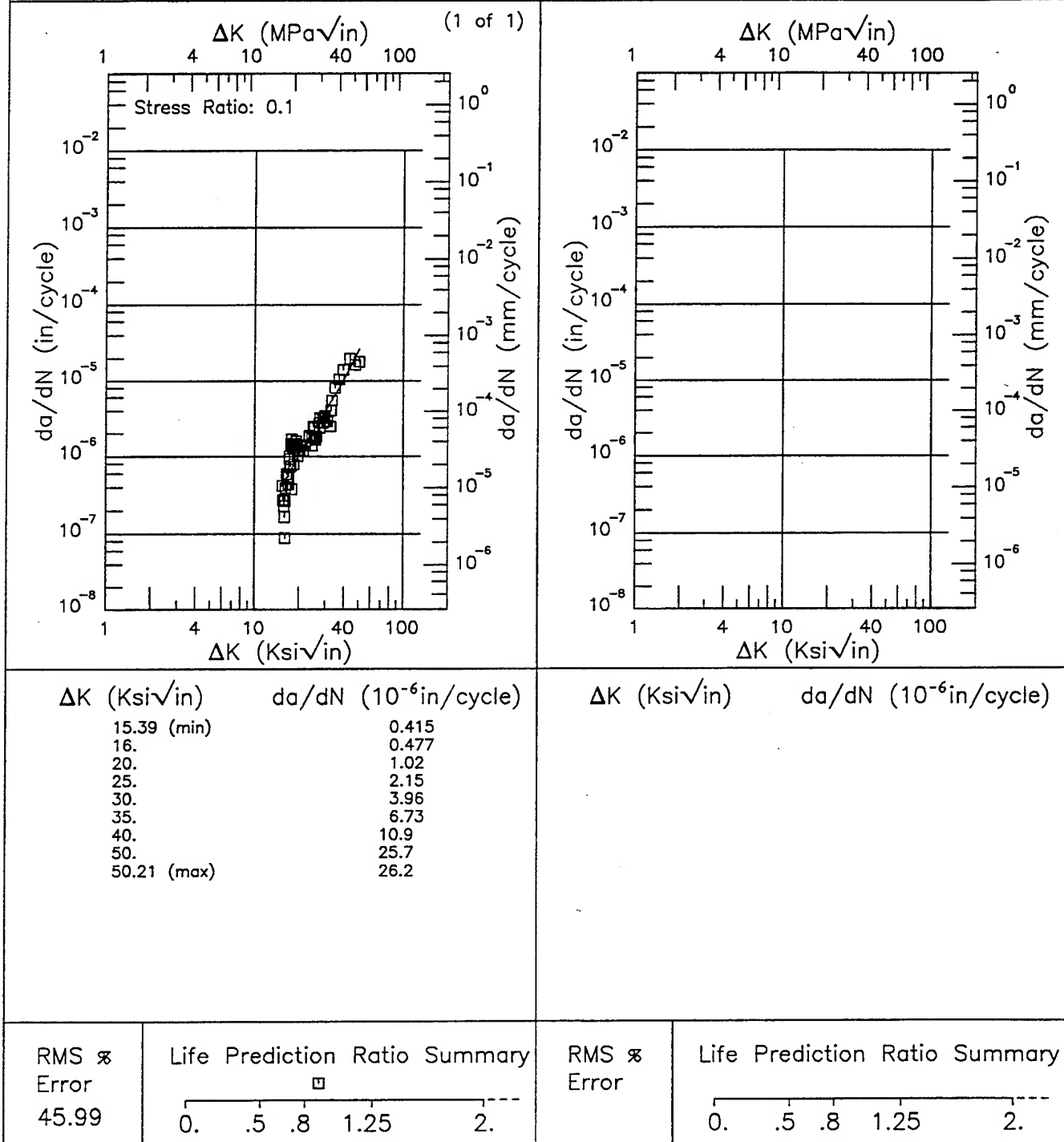


Figure 5.9.3.1.34

R

## INCONEL 718

Condition/Ht: ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HR  
TO 1150F, 1150F 8HR, AC

Form: 0.75 in. Plate

Specimen Type: CCP (max load specified)

Orientation: L-T

Frequency: 0. Hz

Environment: LAB AIR; 1200°F

Yield Strength: 155 ksi

Ult. Strength: 178 ksi

Specimen Thk: 0.187 in.

Specimen Width: 3 in.

Ref: MA016

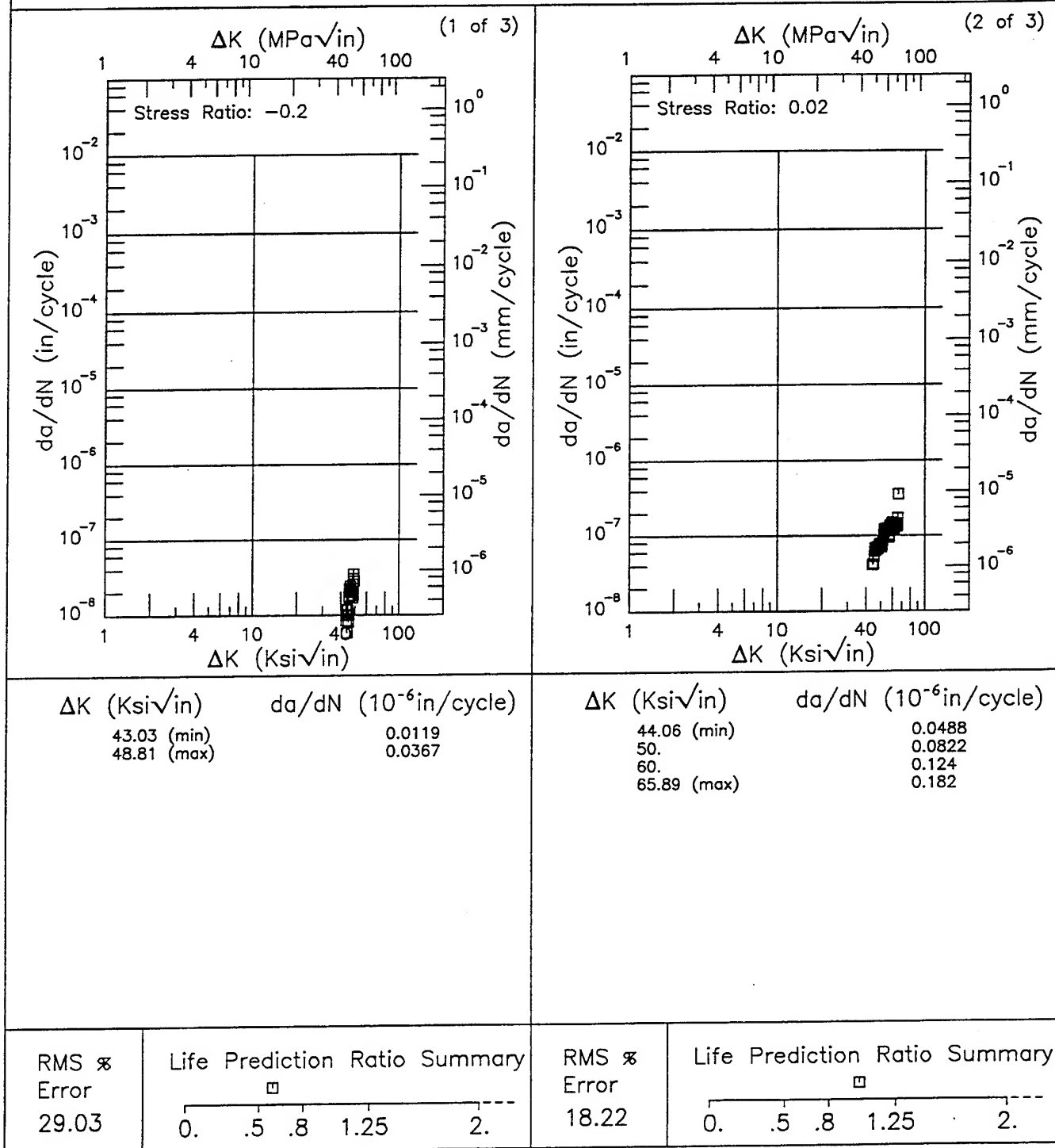


Figure 5.9.3.1.35

# INCONEL 718

R

Condition/Ht: ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HR  
TO 1150F, 1150F 8HR, AC

Form: 0.75 in. Plate

Specimen Type: CCP (max load specified)

Orientation: L-T

Frequency: 0. Hz

Environment: LAB AIR;1200°F

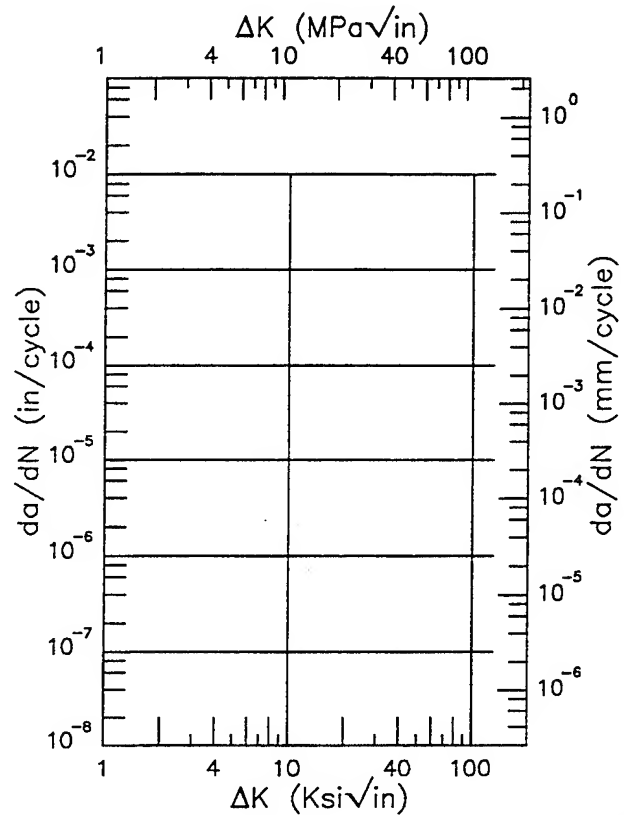
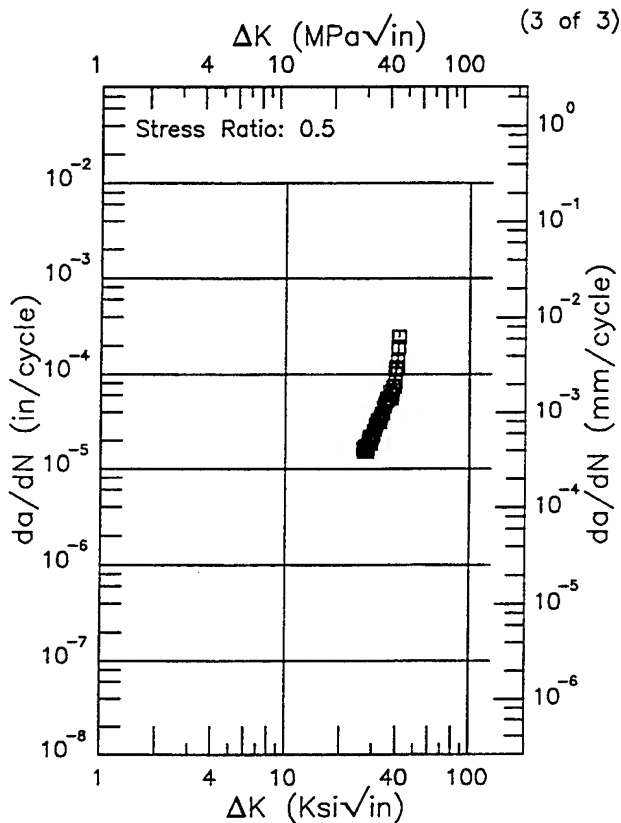
Yield Strength: 155 ksi

Ult. Strength: 178 ksi

Specimen Thk: 0.187 in.

Specimen Width: 3 in.

Ref: MA016



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
26.35 (min)	15.7
30.	23.8
35.	47.5
40.	111.
41.09 (max)	222.

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
-------------	-----------------------------------

RMS %  
Error  
9.83

Life Prediction Ratio Summary  
0. .5 .8 1.25 2. ---

RMS %  
Error

Life Prediction Ratio Summary  
0. .5 .8 1.25 2. ---

Figure 5.9.3.1.35 (Concluded)

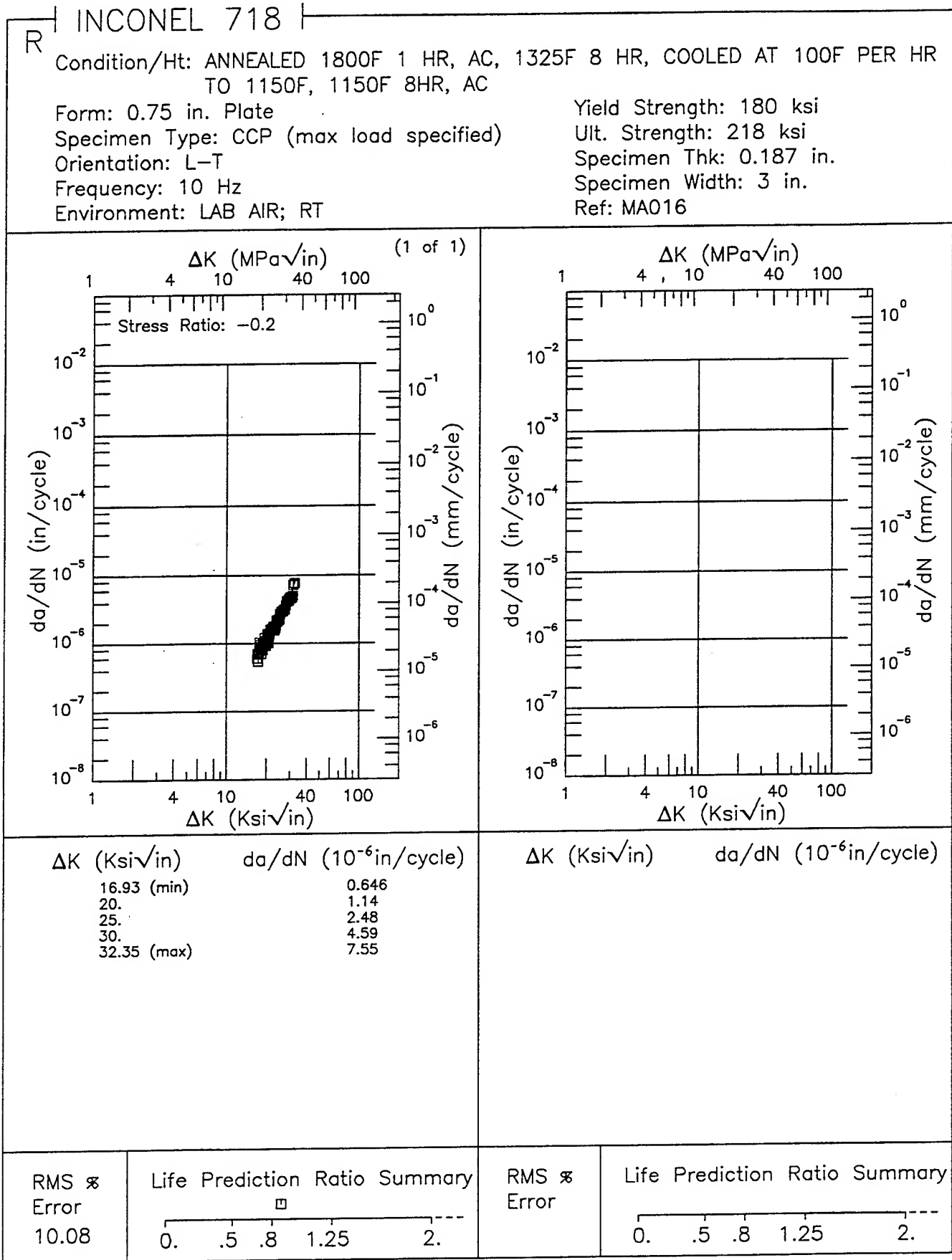


Figure 5.9.3.1.36

**This page intentionally left blank**

# F | INCONEL 718 |

Condition/Ht: ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HR TO 1150F, 1150F 8HR, AC

Form: 0.75 in. Plate

Specimen Type: CCP (max load specified)

Orientation: L-T

Stress Ratio: 0.02

Environment: LAB AIR;1200°F

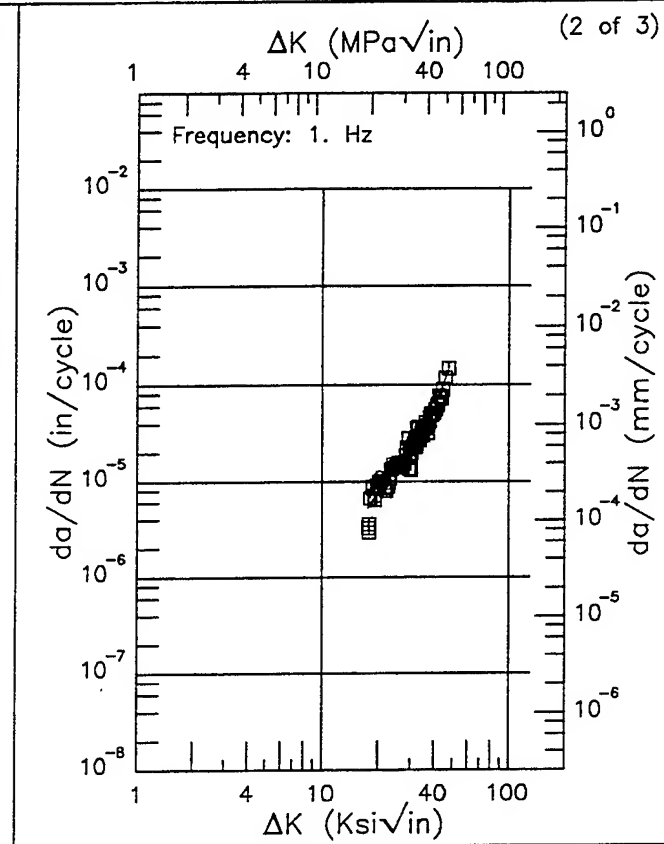
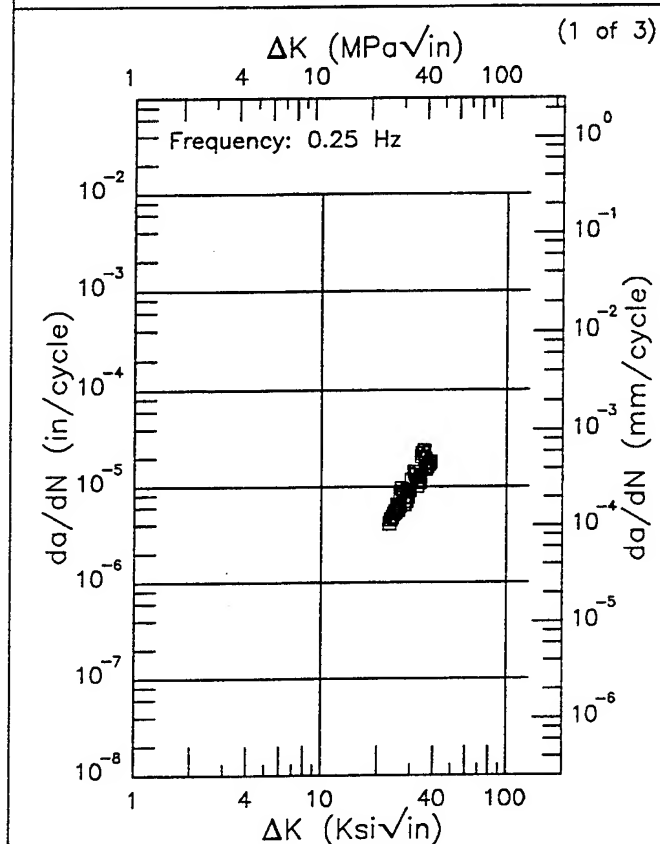
Yield Strength: 155 ksi

Ult. Strength: 178 ksi

Specimen Thk: 0.187 in.

Specimen Width: 3 in.

Ref: MA016

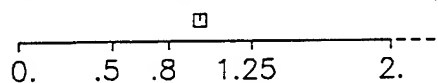


$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
23.08 (min)	3.97
25.	5.88
30.	9.69
35.	17.4
38.50 (max)	16.6

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
17.64 (min)	5.25
20.	8.09
25.	14.3
30.	21.7
35.	33.3
40.	54.9
47.54 (max)	140.

RMS  $\times$   
Error  
16.07

Life Prediction Ratio Summary



RMS  $\times$   
Error  
16.64

Life Prediction Ratio Summary

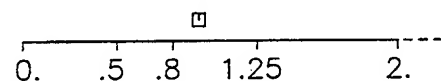


Figure 5.9.3.1.37



# INCONEL 718

Condition/Ht: ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HR  
TO 1150F, 1150F 8HR, AC

Form: 0.75 in. Plate

Specimen Type: CCP (max load specified)

Orientation: L-T

Stress Ratio: 0.02

Environment: LAB AIR;1200°F

Yield Strength: 155 ksi

Ult. Strength: 178 ksi

Specimen Thk: 0.187 in.

Specimen Width: 3 in.

Ref: MA016

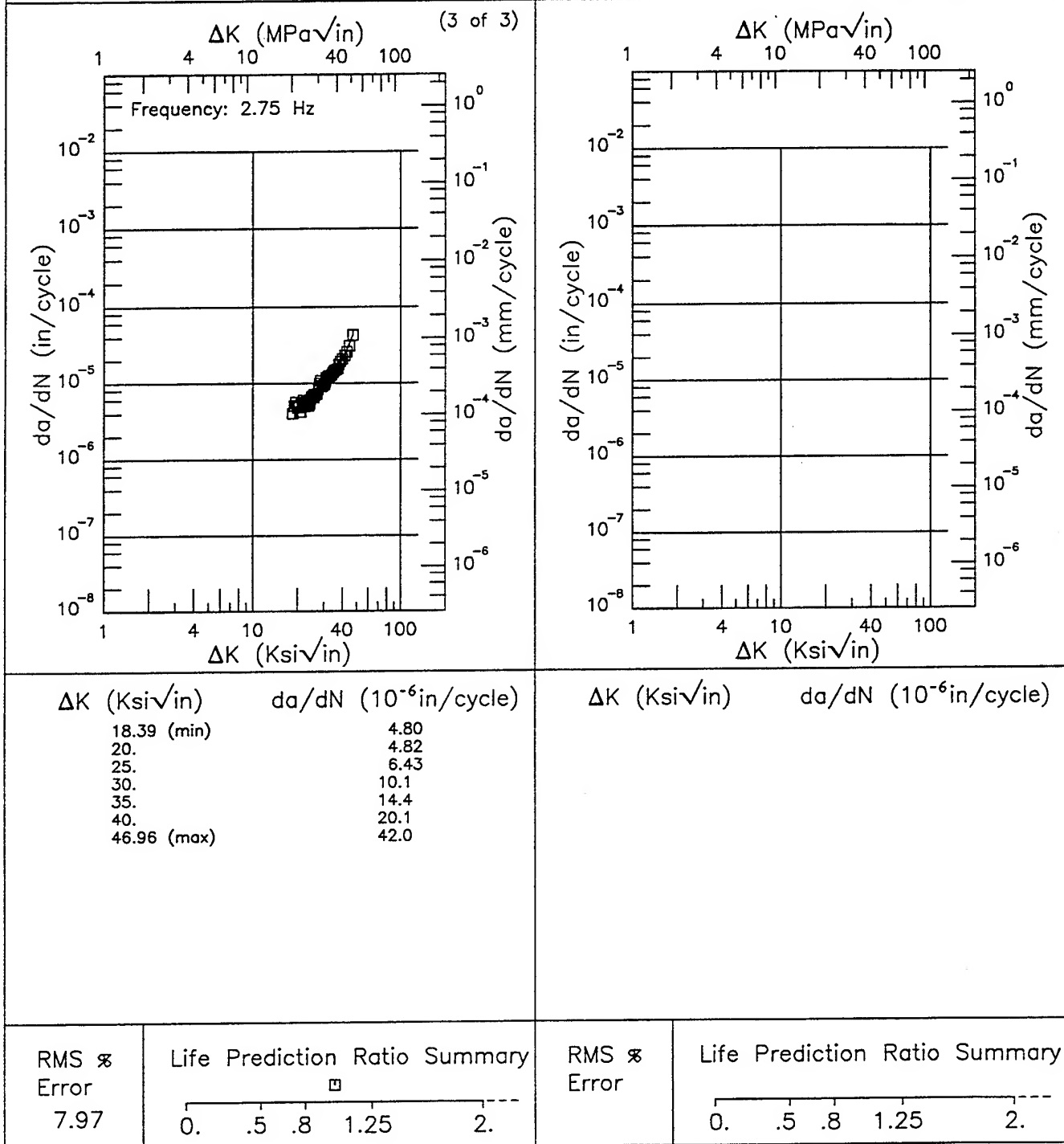


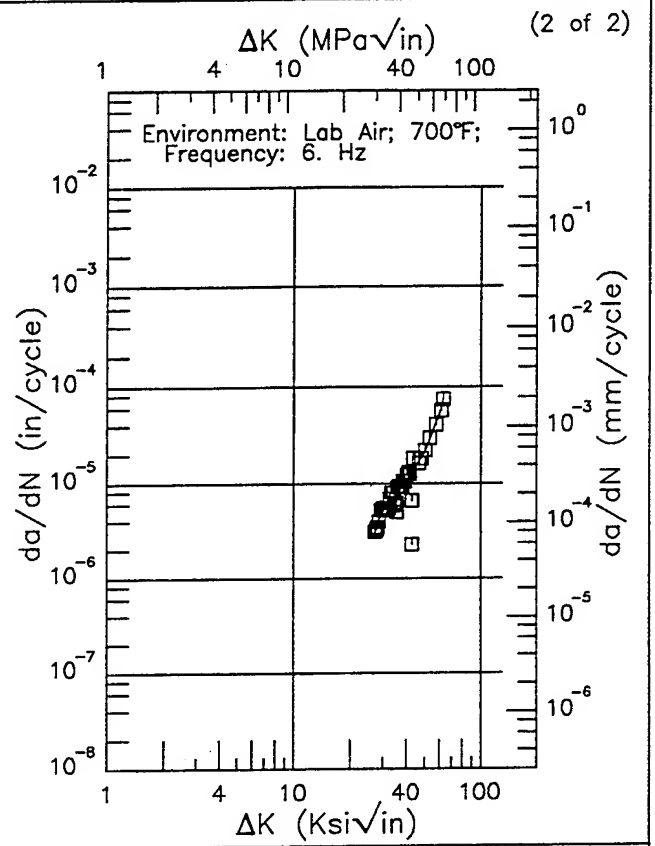
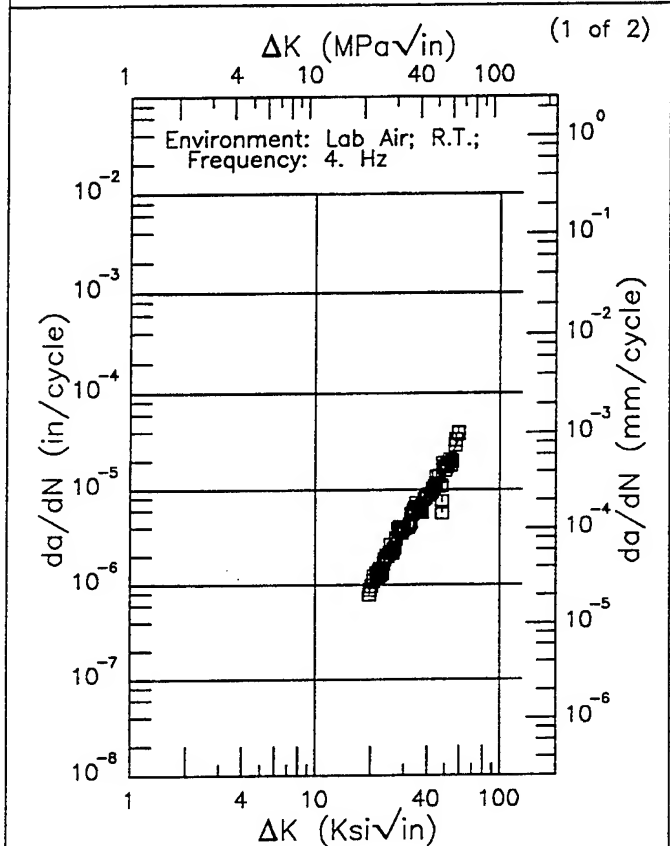
Figure 5.9.3.1.37 (Concluded)

# EF INCONEL 718

Condition/Ht: ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HR TO 1150F, 1150F 8HR, AC

Form: 0.75 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Stress Ratio: 0.02

Yield Strength: 167 – 180 ksi  
 Ult. Strength: 196 – 218 ksi  
 Specimen Thk: 0.187 in.  
 Specimen Width: 3 in.  
 Ref: MA016



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
19.51 (min)	0.814
20.	0.918
25.	2.23
30.	3.85
35.	5.77
40.	8.22
50.	16.4
58.86 (max)	31.9

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
27.11 (min)	3.42
30.	4.99
35.	7.68
40.	10.6
50.	21.1
60.	53.6
62.56 (max)	71.4

RMS % Error	Life Prediction Ratio Summary
13.84	

RMS % Error	Life Prediction Ratio Summary
20.26	

Figure 5.9.3.1.38

# INCONEL 718

EF

Condition/Ht: ANNEALED 1800F 1 HR, AC, 1325F 8 HR, COOLED AT 100F PER HR  
TO 1150F, 1150F 8HR, AC

Form: 0.75 in. Plate

Specimen Type: CCP (max load specified)

Orientation: L-T

Stress Ratio: 0.5

Yield Strength: 155 - 180 ksi

Ult. Strength: 178 - 218 ksi

Specimen Thk: 0.187 in.

Specimen Width: 3 in.

Ref: MA016

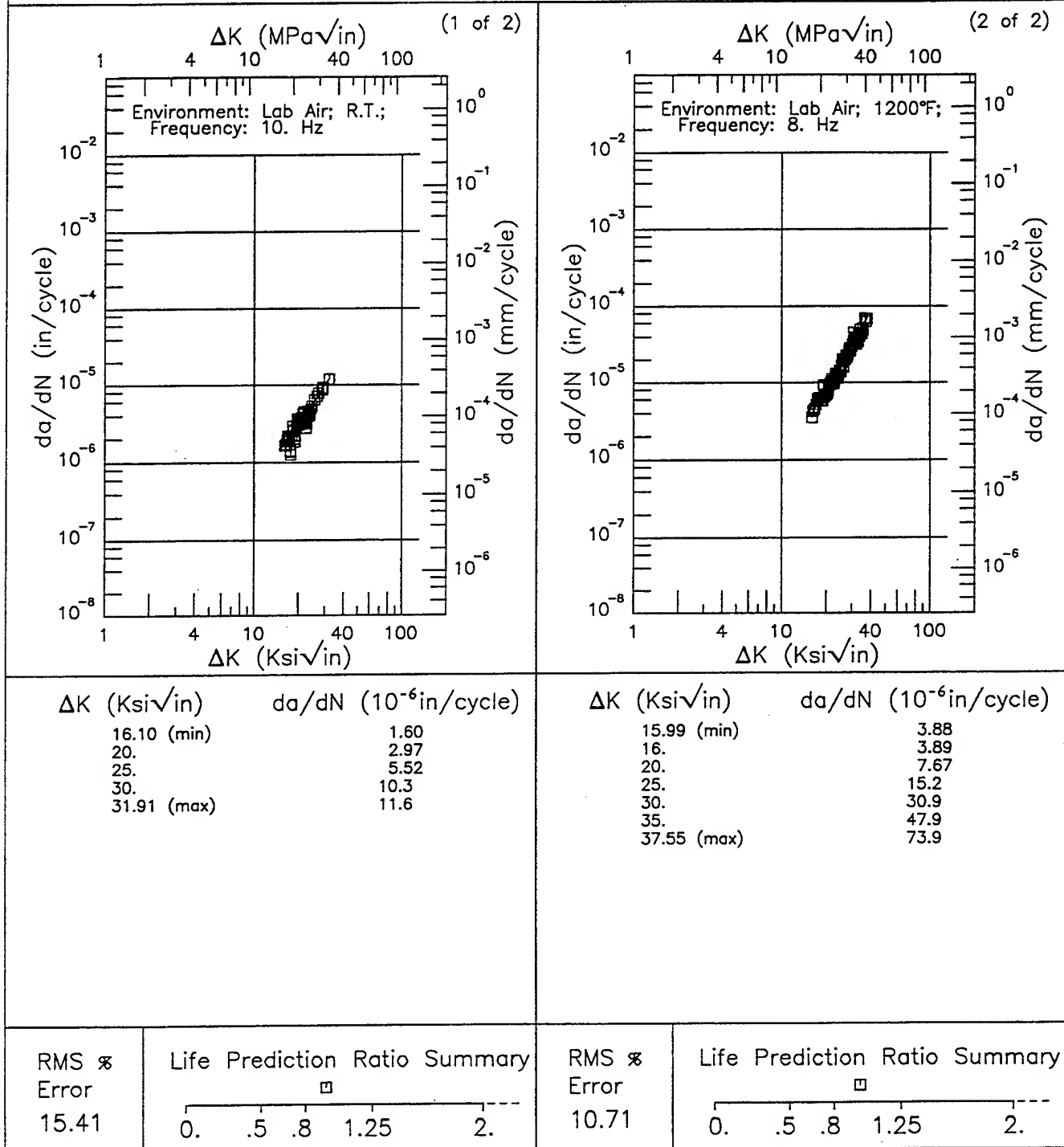


Figure 5.9.3.1.39

# INCONEL 718

Condition/Ht: ST 1850F 1360 F 9HRS F/C 1175F  
 Form: 4 in. Forged Bar  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 6 Hz  
 Environment: L.H.A.; RT

Yield Strength: 160 ksi  
 Ult. Strength: 192 ksi  
 Specimen Thk: 0.5 in.  
 Specimen Width: 5.9 - 6 in.  
 Ref: 88579

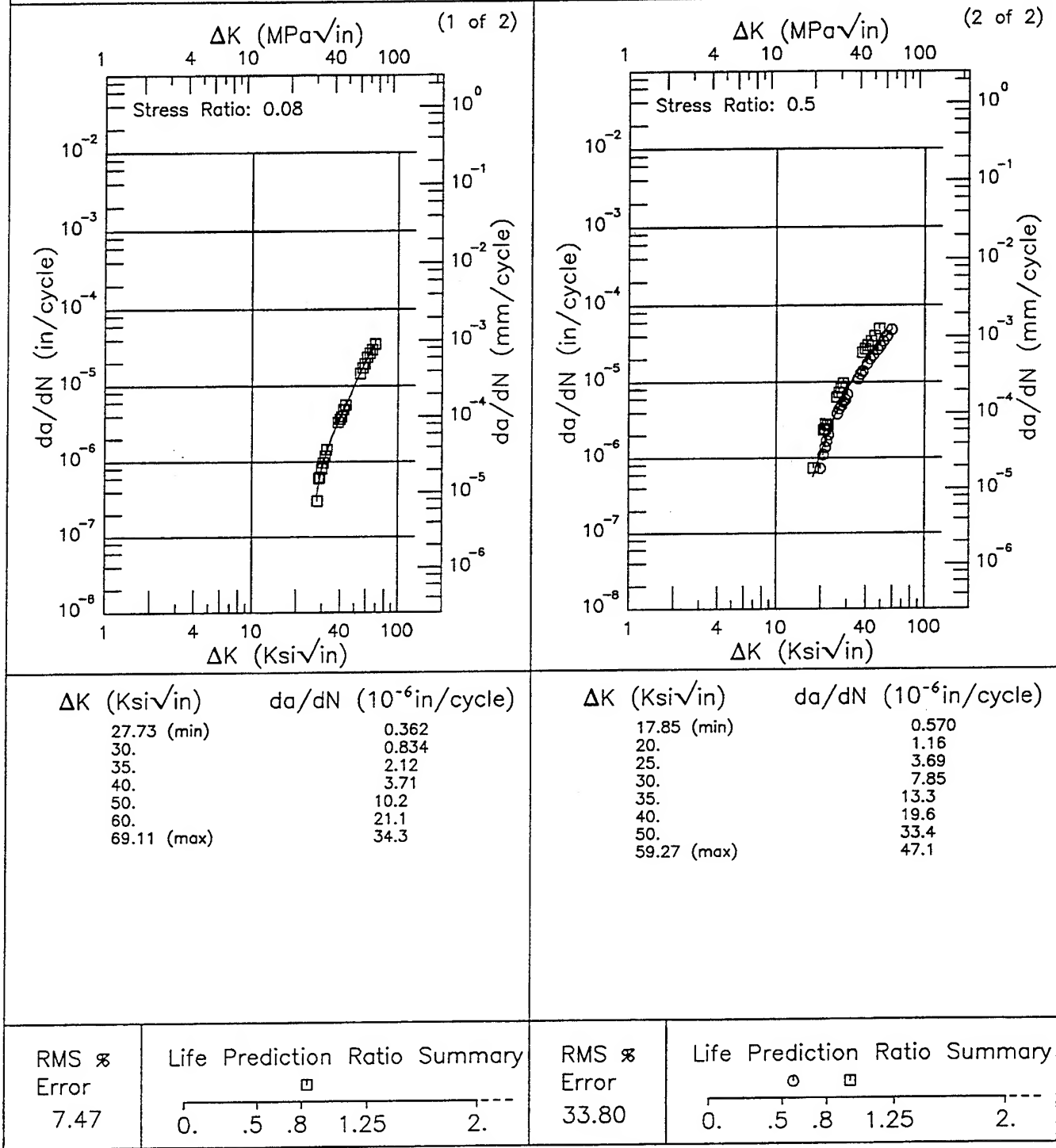


Figure 5.9.3.1.40

Condition/Ht: ST 1850F 1360 F 9HRS F/C 1175F

Form: 4 in. Forged Bar

Specimen Type: CT

Orientation: L-T

Stress Ratio: 0.08

Yield Strength: 160 ksi

Ult. Strength: 192 ksi

Specimen Thk: 0.5 in.

Specimen Width: 5.99 - 6 in.

Ref: 88579

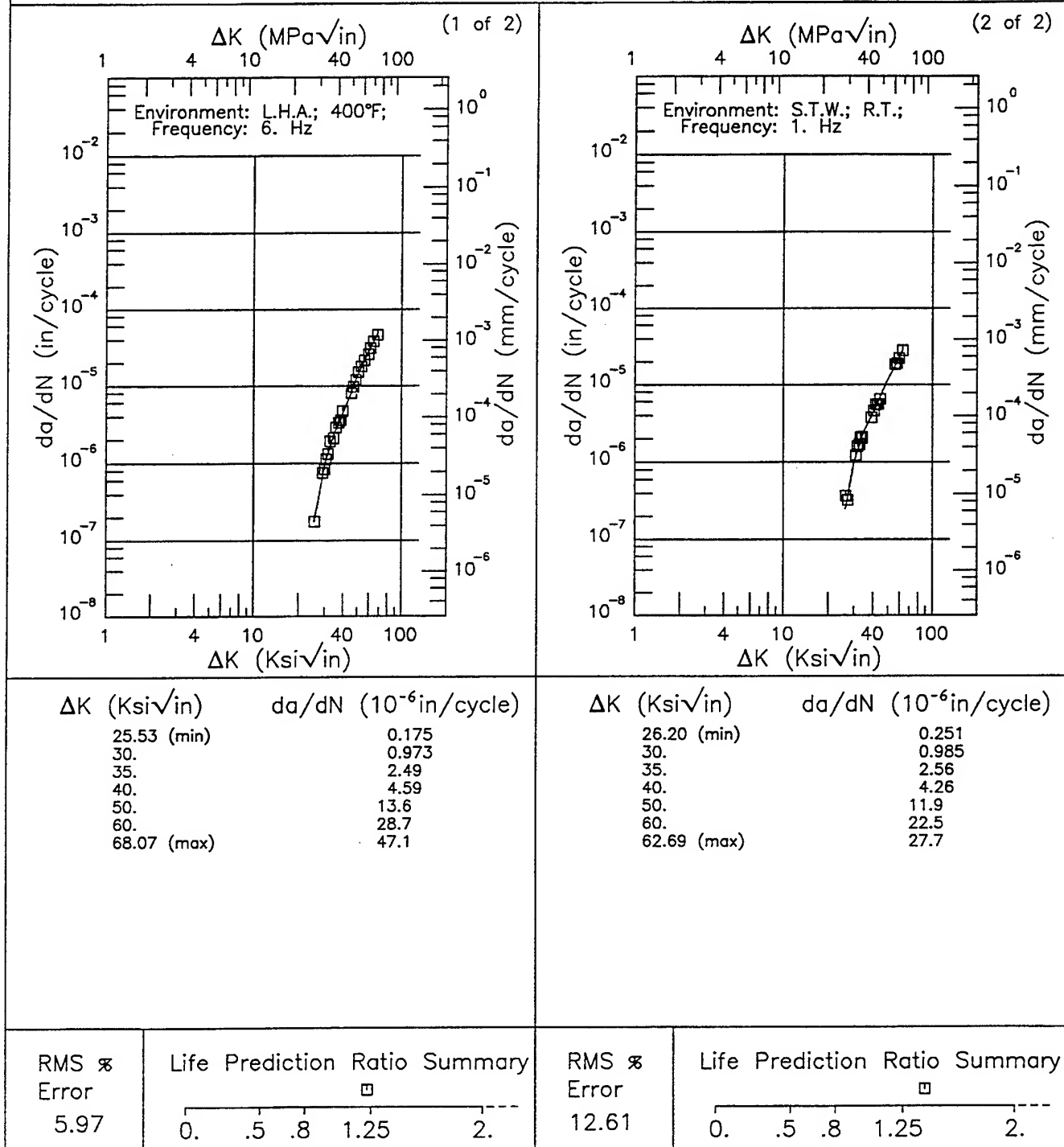


Figure 5.9.3.1.41

# INCONEL 718

EF

Condition/Ht: ST 1850F 1360 F 9HRS F/C 1175F  
 Form: 4 in. Forged Bar  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.08

Yield Strength: 160 ksi  
 Ult. Strength: 192 ksi  
 Specimen Thk: 0.5 - 0.51 in.  
 Specimen Width: 7.39 - 7.4 in.  
 Ref: 88579

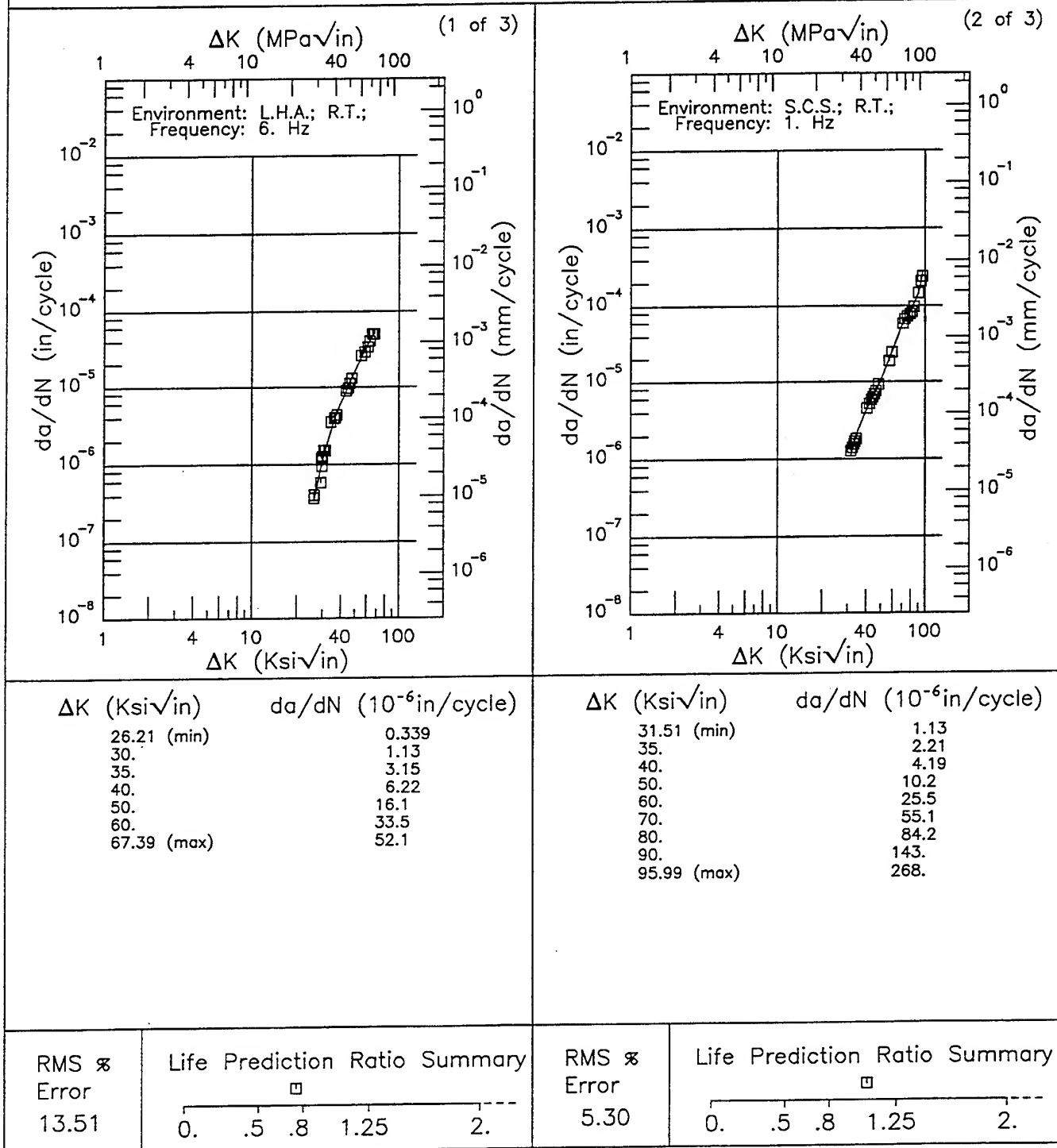


Figure 5.9.3.1.42

Condition/Ht: ST 1850F 1360 F 9HRS F/C 1175F  
 Form: 4 in. Forged Bar  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.08

Yield Strength: 160 ksi  
 Ult. Strength: 192 ksi  
 Specimen Thk: 0.5 - 0.51 in.  
 Specimen Width: 7.39 - 7.4 in.  
 Ref: 88579

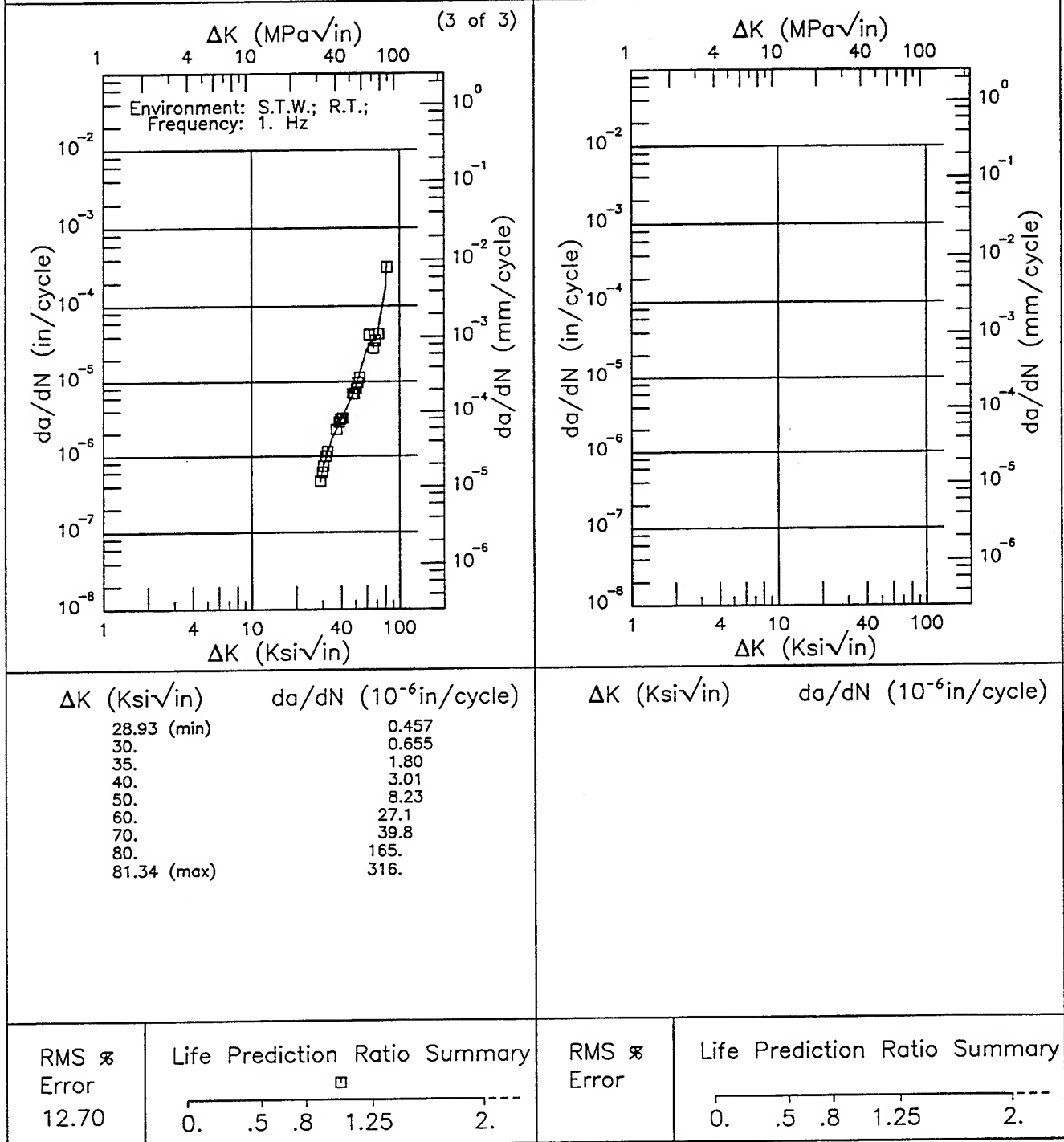


Figure 5.9.3.1.42 (Concluded)

# INCONEL 718

Condition/Ht: ST 1850F 1360 F 9HRS F/C 1175F  
Form: 4 in. Forged Bar  
Specimen Type: CT  
Orientation: S-L  
Stress Ratio: 0.08

Yield Strength: 160 ksi  
Ult. Strength: 192 ksi  
Specimen Thk: 1 in.  
Specimen Width: 3.77 in.  
Ref: 88579

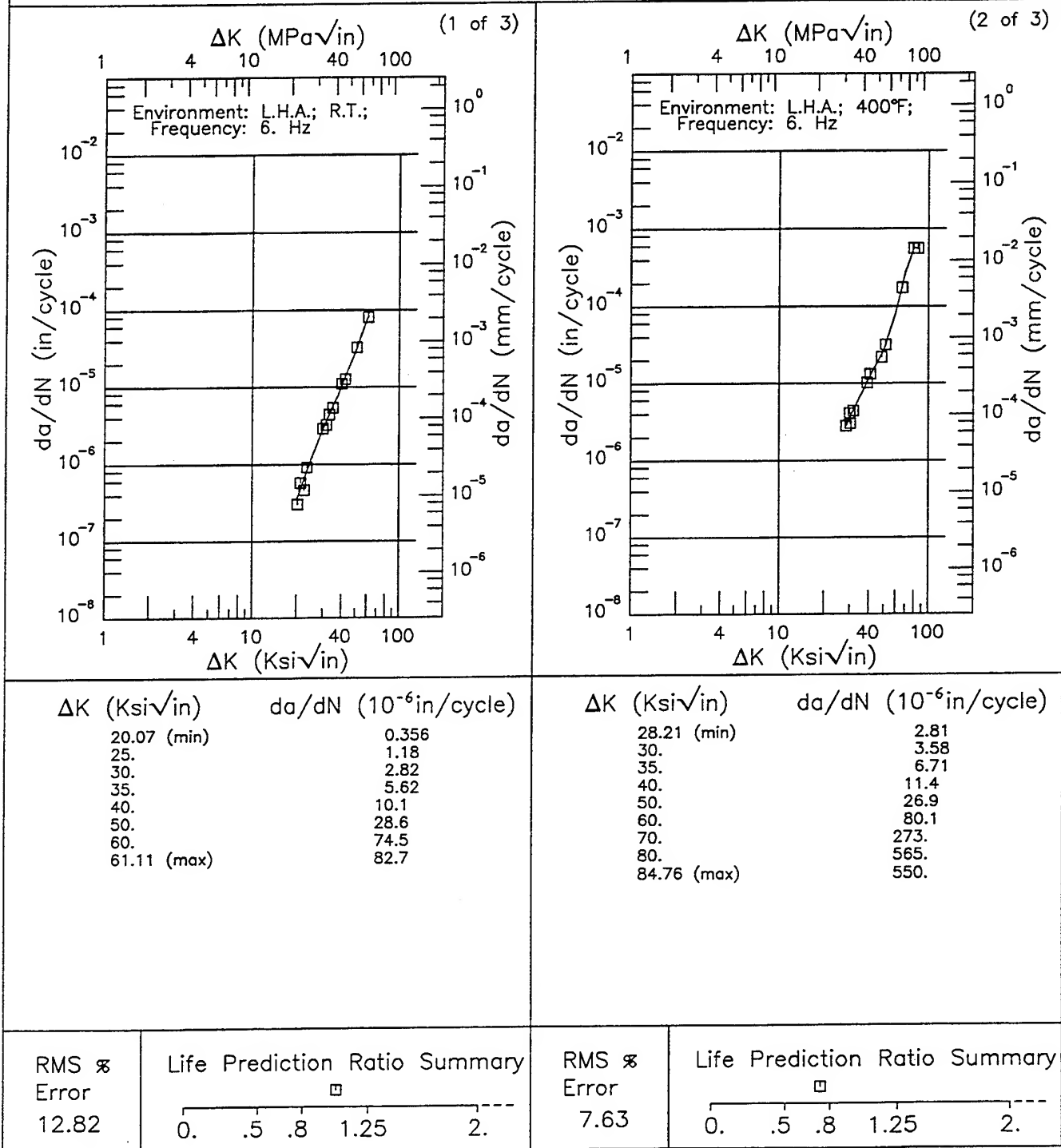


Figure 5.9.3.1.43



Condition/Ht: ST 1850F 1360 F 9HRS F/C 1175F  
 Form: 4 in. Forged Bar  
 Specimen Type: CT  
 Orientation: S-L  
 Stress Ratio: 0.08

Yield Strength: 160 ksi  
 Ult. Strength: 192 ksi  
 Specimen Thk: 1 in.  
 Specimen Width: 3.77 in.  
 Ref: 88579

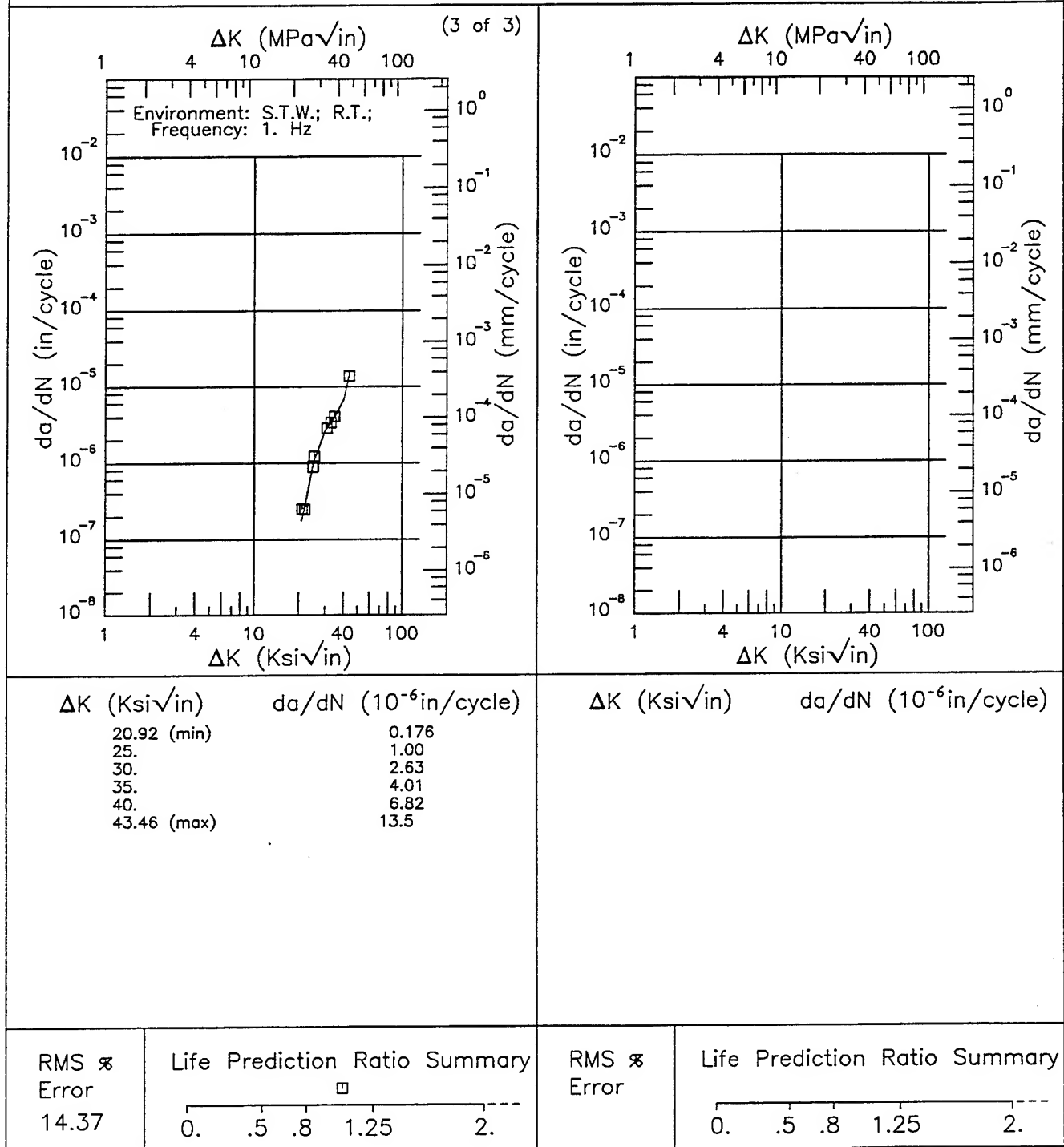
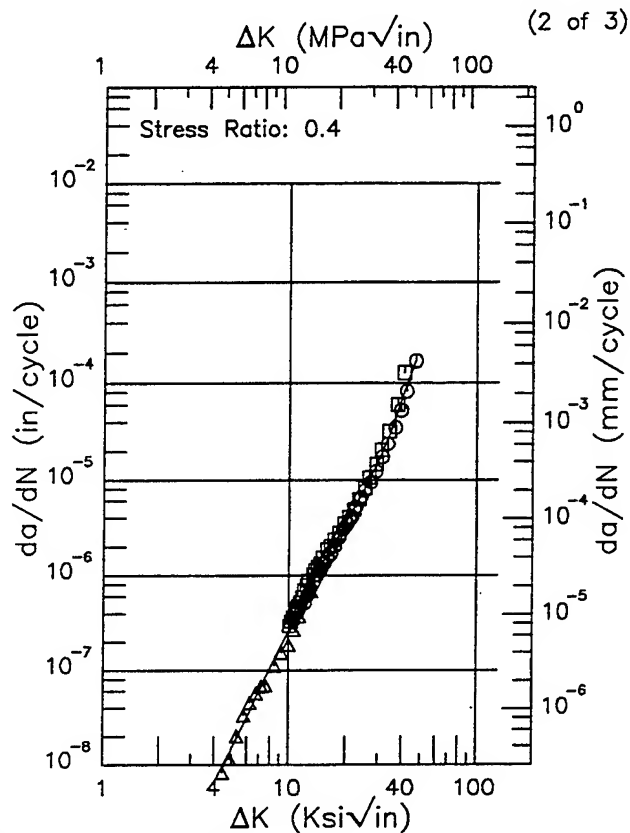
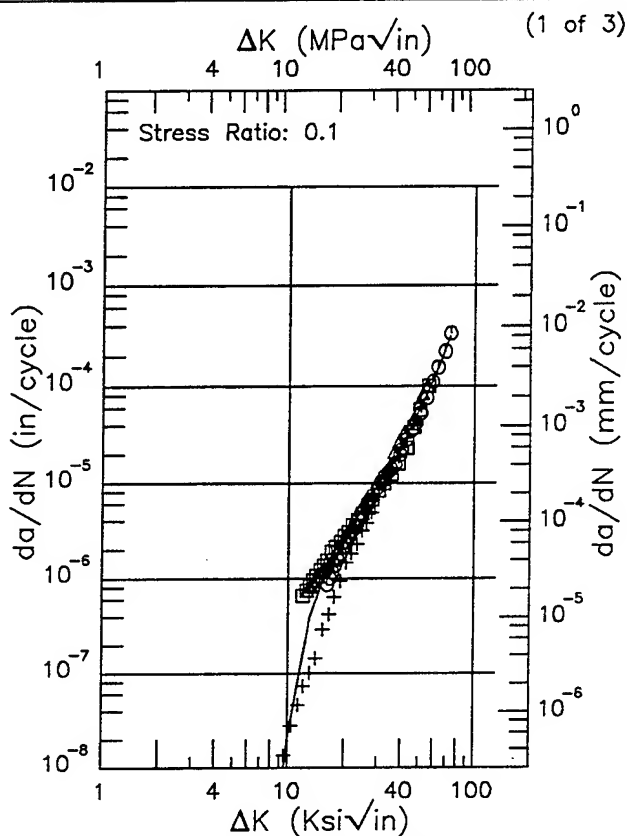


Figure 5.9.3.1.43 (Concluded)

# R INCONEL 718

Condition/Ht: STA  
Form: 3 in. Forging  
Specimen Type: CT  
Orientation: L-T  
Frequency: 15 - 30 Hz  
Environment: LAB AIR; RT

Yield Strength: 161.2 - 177.4 ksi  
Ult. Strength:  
Specimen Thk: 0.244 - 0.254 in.  
Specimen Width: 2.002 - 2.005 in.  
Ref: DA006;DA007



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
9.50 (min)	0.00991
10.	0.0218
13.	0.381
16.	1.24
20.	2.42
25.	4.11
30.	7.59
35.	14.2
40.	24.5
50.	56.4
60.	121.
70.	252.
73.51 (max)	313.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
4.45 (min)	0.00926
5.	0.0149
6.	0.0318
7.	0.0605
8.	0.105
9.	0.171
10.	0.263
13.	0.739
16.	1.60
20.	3.51
25.	7.75
30.	15.7
35.	32.5
40.	71.5
46.73 (max)	163.

RMS %  
Error  
55.89

Life Prediction Ratio Summary  
+ ○ □  
0. .5 .8 1.25 2. ---

RMS %  
Error  
14.60

Life Prediction Ratio Summary  
○ □ △  
0. .5 .8 1.25 2. ---

Figure 5.9.3.1.44

Condition/Ht: STA  
Form: 3 in. Forging  
Specimen Type: CT  
Orientation: L-T  
Frequency: 15 - 30 Hz  
Environment: LAB AIR; RT

Yield Strength: 161.2 - 177.4 ksi  
Ult. Strength:  
Specimen Thk: 0.244 - 0.254 in.  
Specimen Width: 2.002 - 2.005 in.  
Ref: DA006;DA007

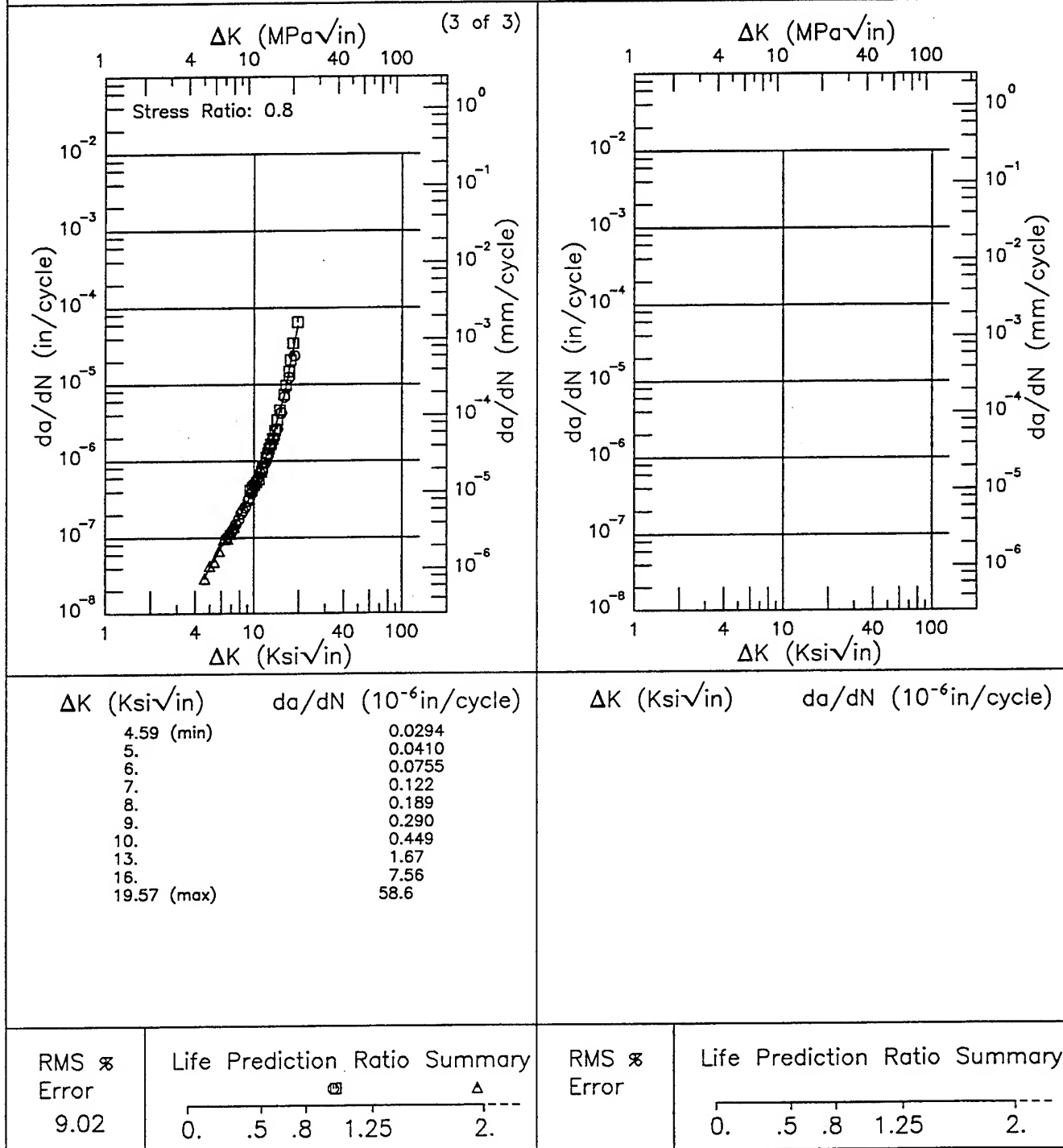


Figure 5.9.3.144 (Concluded)

R

## INCONEL 718

Condition/Ht: STA  
 Form: 3 in. Forging  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 1 Hz  
 Environment: DIST WATER; RT

Yield Strength: 161.2 ksi  
 Ult. Strength:  
 Specimen Thk: 0.249 - 0.25 in.  
 Specimen Width: 2.002 - 2.005 in.  
 Ref: DA007

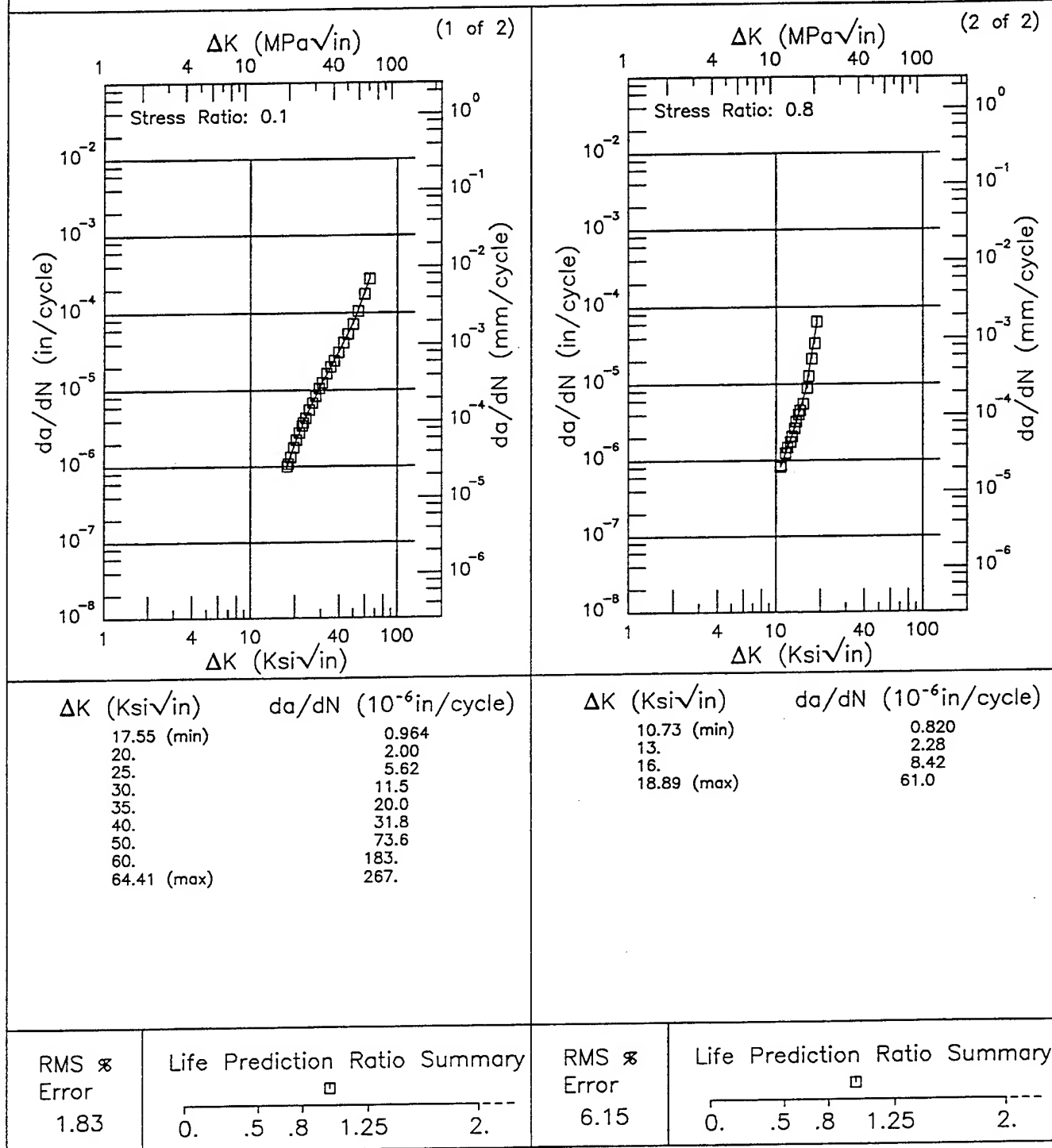


Figure 5.9.3.1.45

**This page intentionally left blank**

# R INCONEL 718

Condition/Ht: STA  
Form: 3 in. Forging  
Specimen Type: CT  
Orientation: T-L  
Frequency: 5 - 30 Hz  
Environment: LAB AIR; RT

Yield Strength: 155.4 - 169. ksi  
Ult. Strength:  
Specimen Thk: 0.25 - 0.254 in.  
Specimen Width: 2.001 - 2.007 in.  
Ref: DA006;DA007

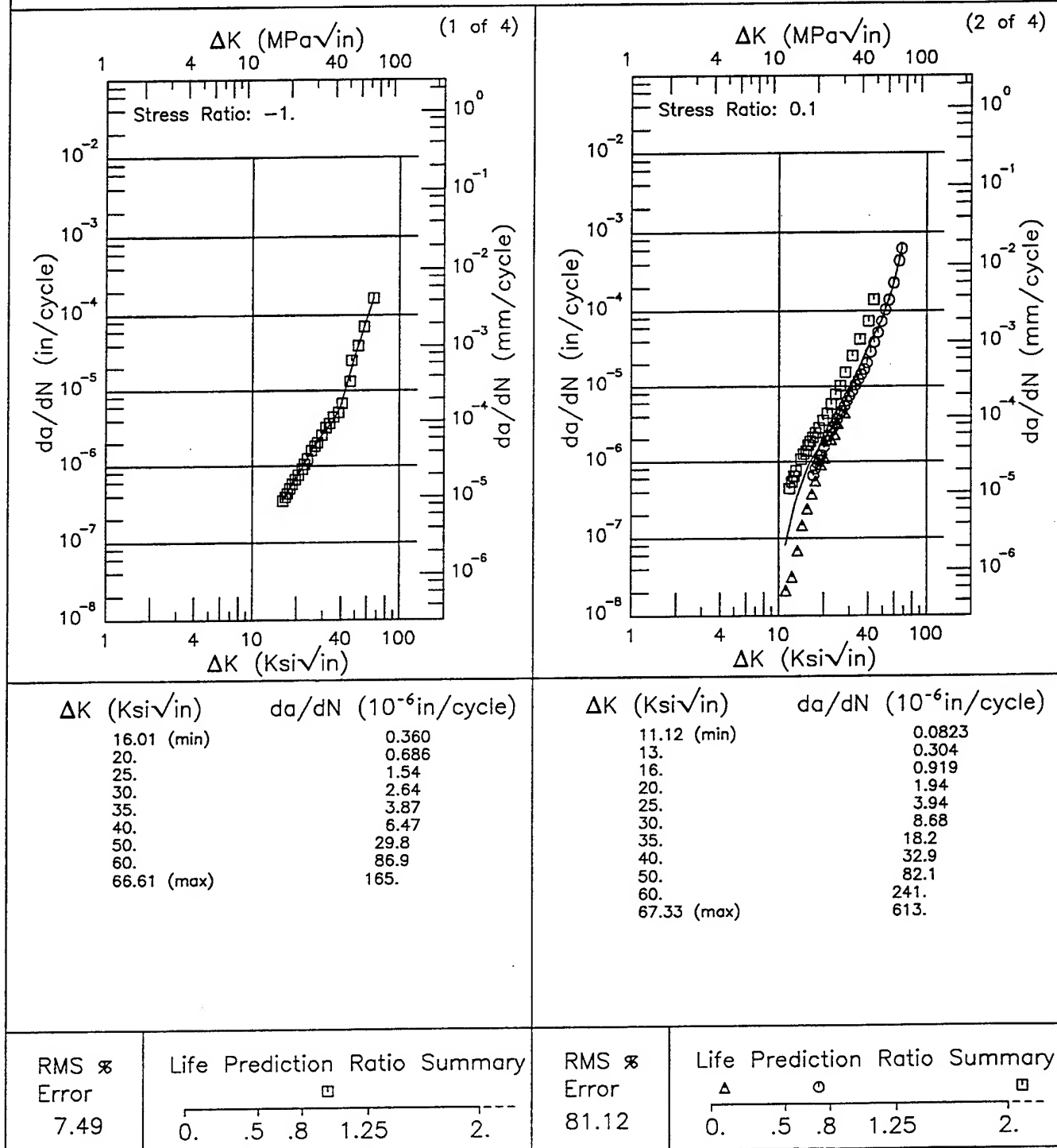


Figure 5.9.3.1.46

Condition/Ht: STA  
 Form: 3 in. Forging  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 5 - 30 Hz  
 Environment: LAB AIR; RT

Yield Strength: 155.4 - 169. ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.254 in.  
 Specimen Width: 2.001 - 2.007 in.  
 Ref: DA006;DA007

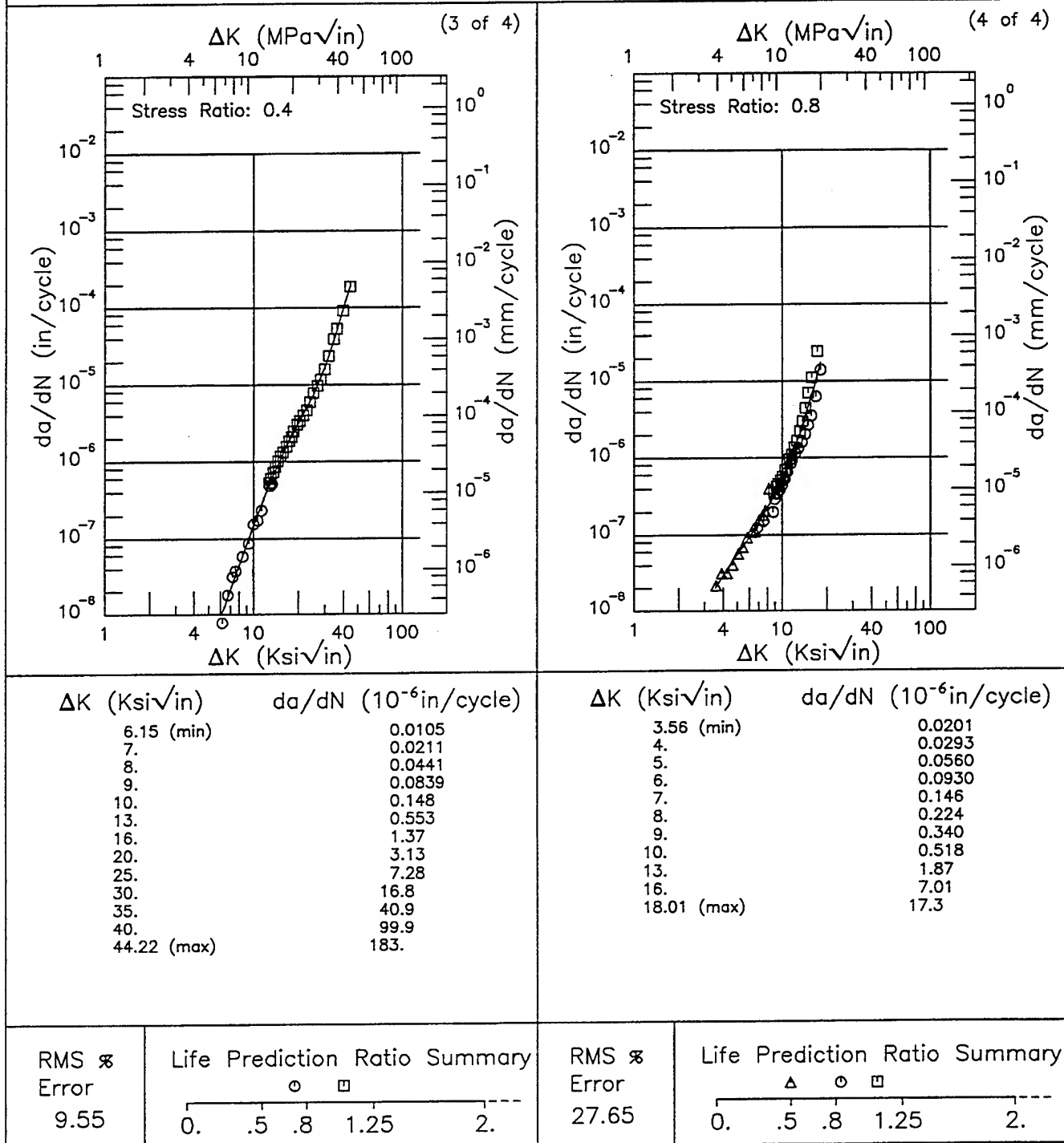
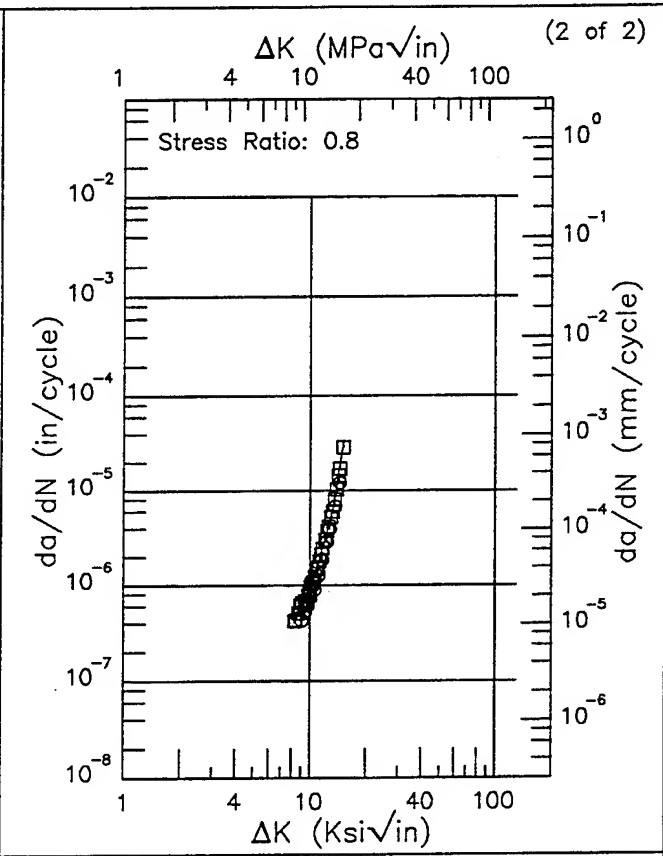
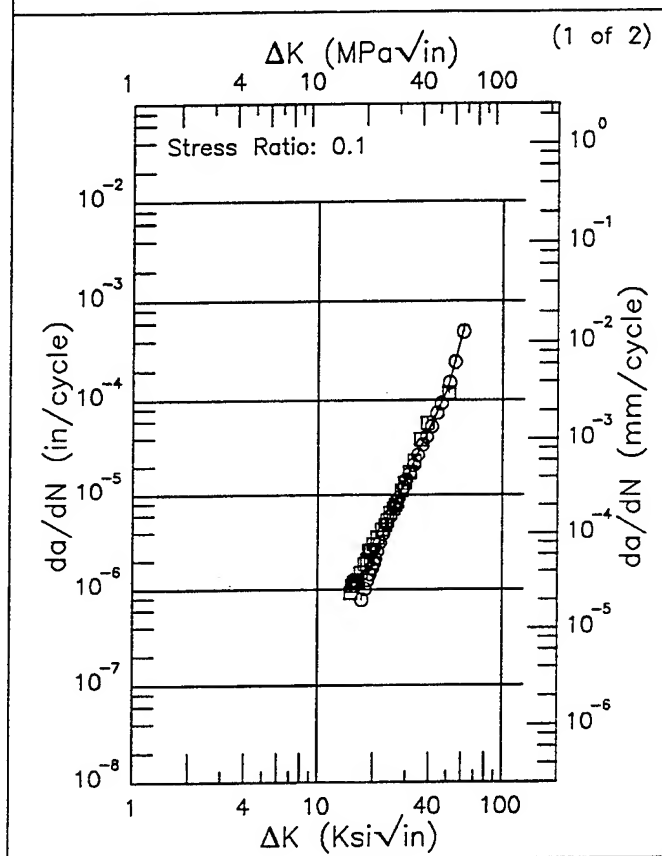


Figure 5.9.3.1.46 (Concluded)

# R | INCONEL 718 |

Condition/Ht: STA  
 Form: 3 in. Forging  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 1 Hz  
 Environment: DIST WATER; RT

Yield Strength: 155.4 - 169. ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.252 in.  
 Specimen Width: 2.003 - 2.005 in.  
 Ref: DA006;DA007



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
15.08 (min)	0.951
16.	1.09
20.	2.30
25.	6.21
30.	14.8
35.	29.7
40.	50.4
50.	127.
60.	449.
60.84 (max)	510.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.25 (min)	0.403
9.	0.555
10.	0.826
13.	5.08
14.97 (max)	28.5

RMS % Error	Life Prediction Ratio Summary
14.98	

RMS % Error	Life Prediction Ratio Summary
12.36	

Figure 5.9.3.1.47



Condition/Ht: STA  
Form: 3 in. Forging  
Specimen Type: CCP (max load specified)  
Orientation: L-T  
Frequency: 5 Hz  
Environment: LAB AIR; RT

Yield Strength: 177.2 ksi  
Ult. Strength:  
Specimen Thk: 0.204 in.  
Specimen Width: 4.008 in.  
Ref: DA006

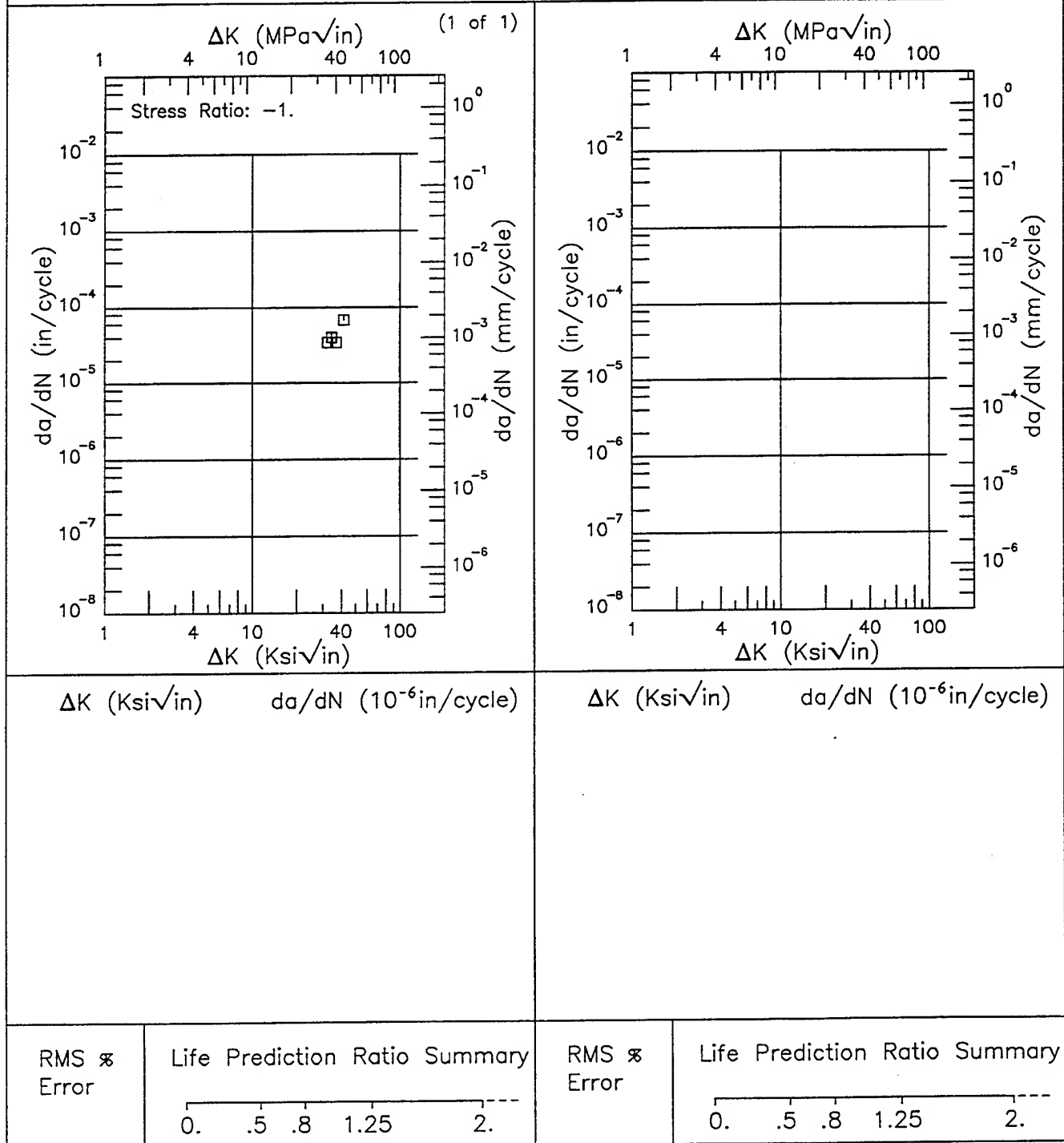


Figure 5.9.3.1.48

(1 of 2)

TABLE 5.9.3.3

**K<sub>Iacc</sub> SUMMARY FOR NICKEL-BASED SUPER ALLOY INCONEL 718**

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	K <sub>Q</sub> (Ksi√in)	K <sub>Iacc</sub> (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)							
1850F 1.5HR OQ; 1360F 9HRS FC TO 1175F OQ; 1360F 9HRS FC TO 1175F	FB	R.T.	L-T	160	S.C.S.	DCB	2	1	4	---	193	>186*	60180	1976	RI006
						DCB	2	1	4	---	193	>86	60180	1976	RI006
						DCB	2	1	4	---	103	>86	60060	1976	RI006
						DCB	2	1	4	---	103	>180*	119100	1976	RI006
			T-L	160	S.T.W.	DCB	2	1	4	---	104	>89	60060	1976	RI006
						DCB	2	1	4	---	104	121*	119100	1976	RI006
						DCB	2	1	4	---	104	>87	60120	1976	RI006
						DCB	2	1	4	---	104	>99	76380	1976	RI006
			S-L	160	S.T.W.	DCB	2	1	4	---	104	>99	76380	1976	RI006
						DCB	2	1	4	---	104	>99	76380	1976	RI006

TABLE 5.9.3.3 (CONCLUDED)

(2 of 2)

 $K_{Iacc}$  SUMMARY FOR NICKEL-BASED SUPER ALLOY INCONEL 718

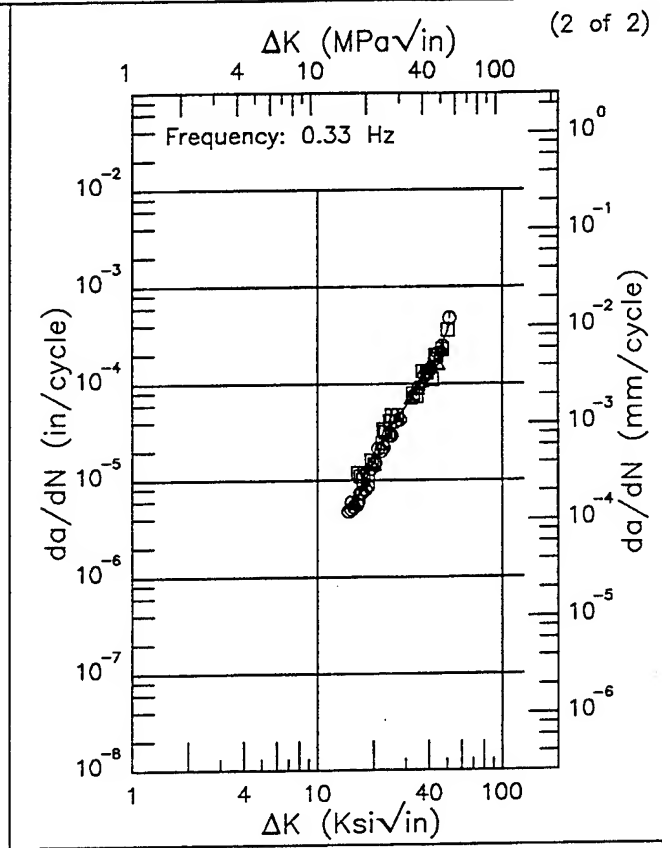
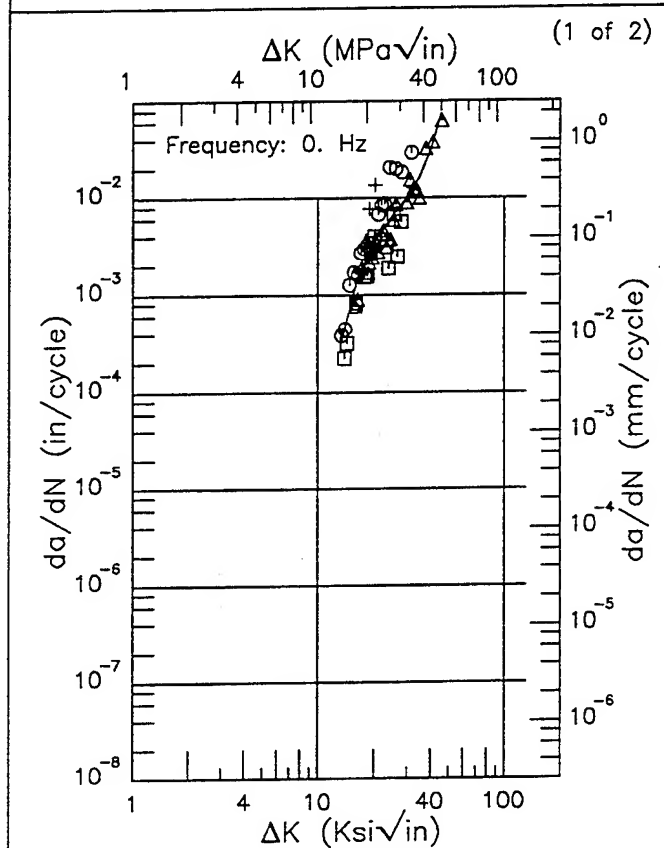
Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	$K_Q$ (Ksi√in)	$K_{Iacc}$ (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)							
1880F 1HR AC; 1520F 8HR FC; 1200F 16HR AC; 1520F 8HR FC; 1200F 16HR AC	s	R.T.	---	---	Aerotime 50	WOL	1.3	0.125	0.13	---	---	80*	---	1974	88700
					Martin- Marietta refined grade hydrazine	WOL	1.3	0.125	0.13	---	---	79*	---	1974	88700
					Martin- Marietta refined grade hydrazine 2% oxygen	WOL	1.3	0.125	0.13	---	---	79*	---	1974	88700
					Matheson- Coleman-Bell 97% grade hydrazine	WOL	1.3	0.125	0.13	---	---	25.8*	---	1974	88700
					Propellant grade hydrazine	WOL	1.3	0.125	0.13	---	---	87.5*	---	1974	88700

\* specimen thickness does not meet minimum requirements of  $2.5 \left( \frac{K_{Iacc}}{\sigma_{yp}} \right)^2$

F | NASA IIB-7 P/M |

Condition/Ht: 1650F 16HRS TO 2000F 1HR OQ  
 Form: 1.75 in. Disk  
 Specimen Type: WOL  
 Orientation: C-R  
 Stress Ratio: 0.05  
 Environment: LAB AIR;1200°F

Yield Strength: 208.6 ksi  
 Ult. Strength: 257.1 ksi  
 Specimen Thk: 0.5 in.  
 Specimen Width: 2.5 in.  
 Ref: PW004



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
13.30 (min)	315.
16.	1303.
20.	3593.
25.	6526.
30.	10084.
35.	16495.
40.	30610.
45.79 (max)	74742.

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
14.67 (min)	4.74
16.	6.09
20.	15.4
25.	36.7
30.	59.0
35.	91.8
40.	141.
50.	338.
51.24 (max)	432.

RMS %  
 Error  
 73.31

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
 Error  
 16.78

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 5.10.3.1

TABLE 5.11.1.2

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**P/M RENE 95 AT ROOM TEMPERATURE**

ORIENTATION: C-R

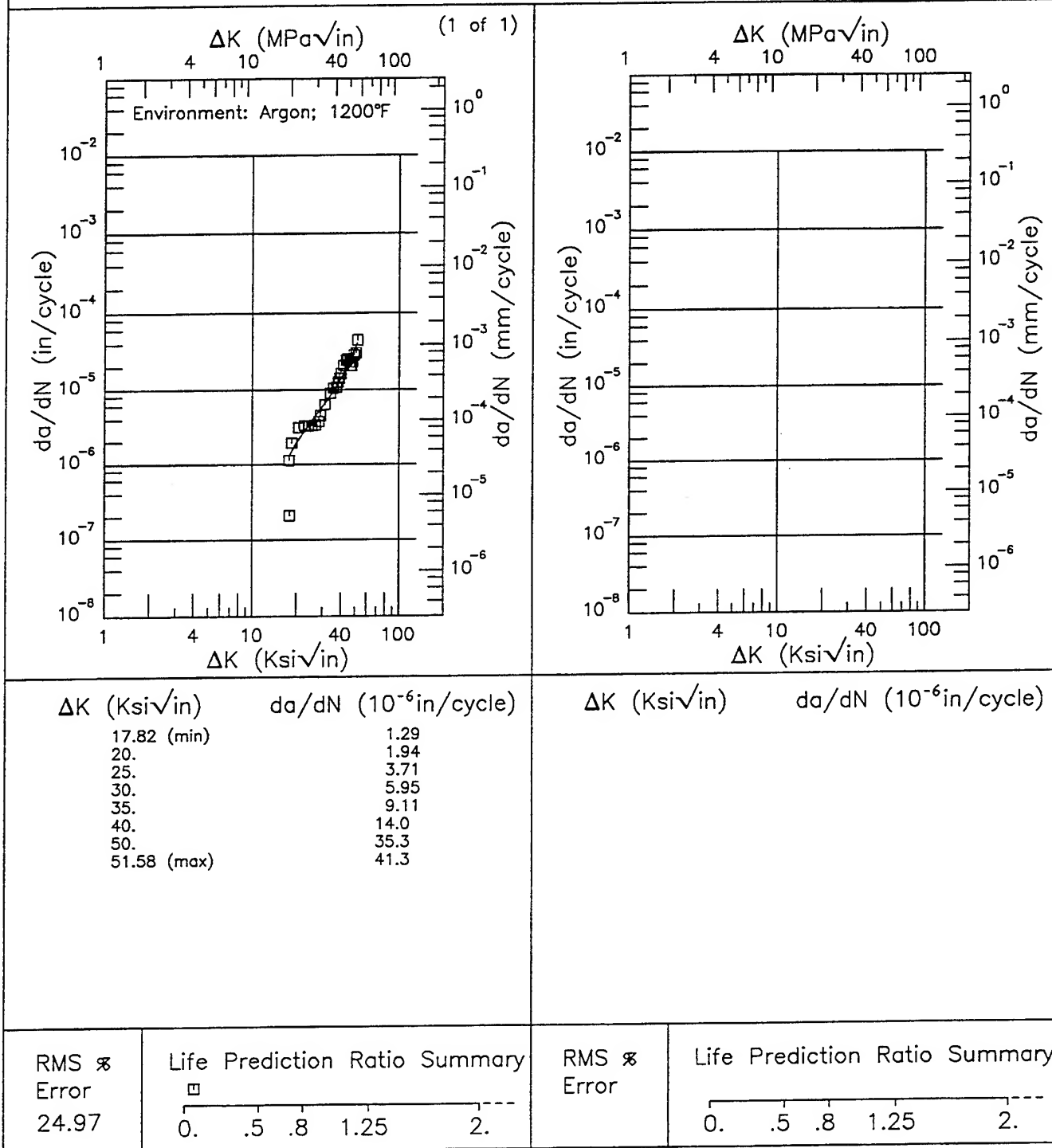
ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)				
				$\Delta K$ Level (Ksi/in)				
				2.5	5.0	10.0	20.0	50.0
2080F 1HR AC 1600F 1HR AC	DISK	0.	0.33				0.4	31.02
								100.0

# E | P/M RENE 95 |

Condition/Ht: 2080F 1HR AC 1600F 1HR AC  
 Form: 2.5 in. Disk  
 Specimen Type: CCP (max load specified)  
 Orientation: C-R  
 Stress Ratio: 0.  
 Frequency: 0.3 Hz

Yield Strength: 165.7 ksi  
 Ult. Strength: 228.6 ksi  
 Specimen Thk: 0.08 in.  
 Specimen Width: 2 in.  
 Ref: GE004



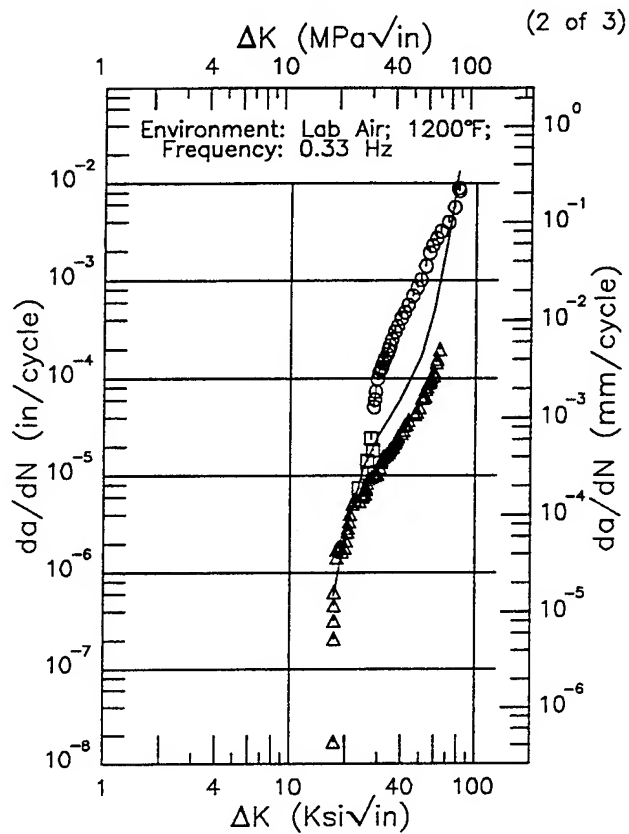
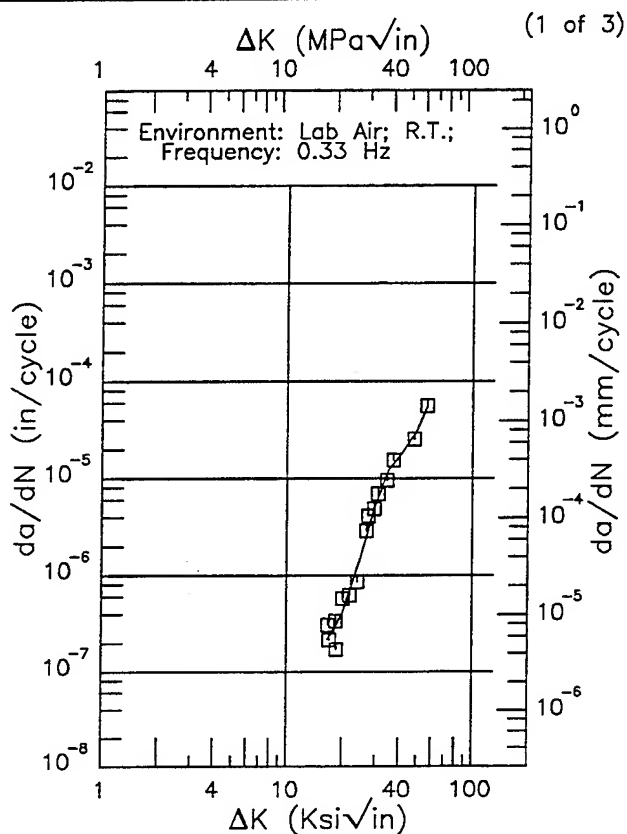
**Figure 5.11.3.1.1**

**This page intentionally left blank**

EF | P/M RENE 95 |

Condition/Ht: 2080F 1HR AC 1600F 1HR AC  
 Form: 2.5 in. Disk  
 Specimen Type: CCP (max stress specified)  
 Orientation: C-R  
 Stress Ratio: 0.

Yield Strength: 165.7 ksi  
 Ult. Strength: 228.6 ksi  
 Specimen Thk: 0.08 in.  
 Specimen Width: 2 in.  
 Ref: GE008



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
16.68 (min)	0.220
20.	0.400
25.	1.56
30.	5.41
35.	12.2
40.	16.5
50.	31.0
56.41 (max)	55.2

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
17.22 (min)	0.577
20.	2.67
25.	12.0
30.	25.7
35.	42.0
40.	63.7
50.	159.
60.	517.
70.	2253.
80.	12711.
80.21 (max)	13214.

RMS %  
 Error  
 24.27

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2. ---

RMS %  
 Error  
 >100.0

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2. ---

Figure 5.11.3.1.2



Condition/Ht: 2080F 1HR AC 1600F 1HR AC  
 Form: 2.5 in. Disk  
 Specimen Type: CCP (max stress specified)  
 Orientation: C-R  
 Stress Ratio: 0.

Yield Strength: 165.7 ksi  
 Ult. Strength: 228.6 ksi  
 Specimen Thk: 0.08 in.  
 Specimen Width: 2 in.  
 Ref: GE008

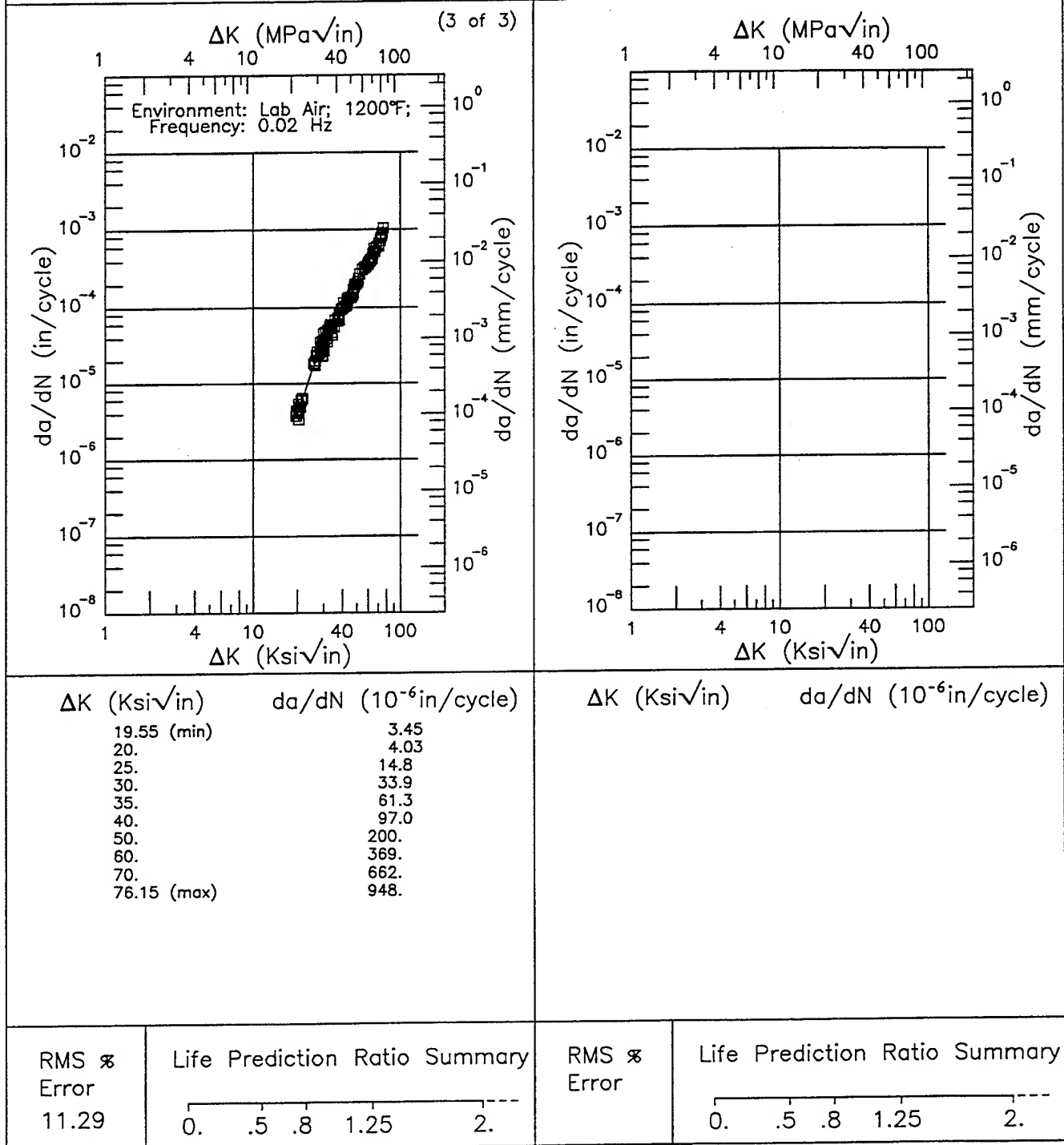
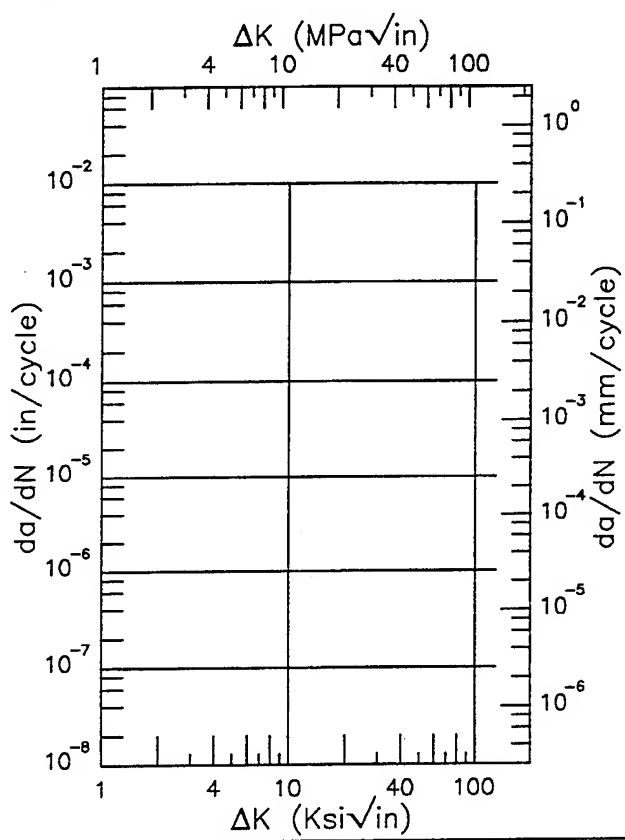
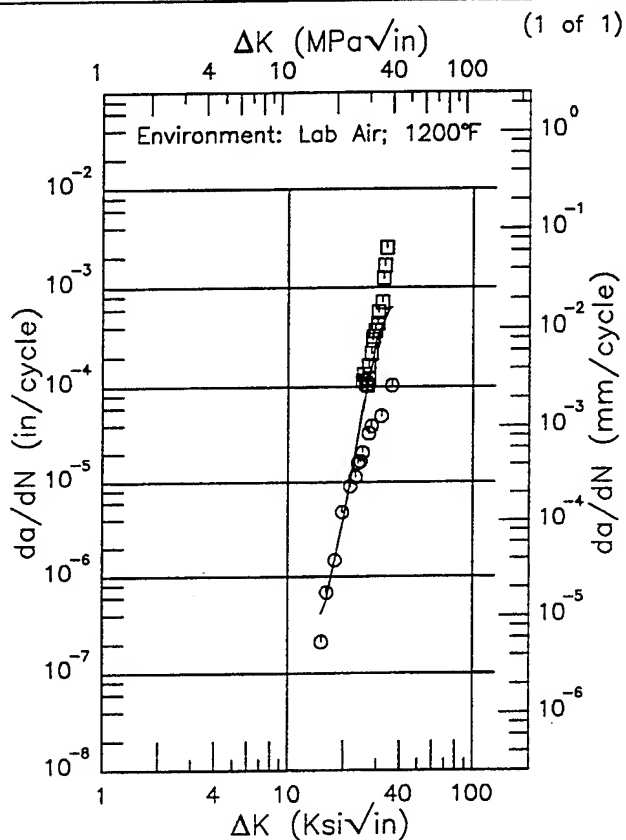


Figure 5.11.3.1.2 (Concluded)

# E | P/M RENE 95 |

Condition/Ht: 2080F 1HR AC 1600F 1HR AC  
 Form: 2.5 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: 0.  
 Frequency: 0.3 Hz

Yield Strength: 165.7 ksi  
 Ult. Strength: 228.6 ksi  
 Specimen Thk: 0.25 in.  
 Specimen Width: 0.6 in.  
 Ref: GE008



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
15.06 (min)	0.413
16.	0.553
20.	4.05
25.	53.0
30.	301.
35.	615.
36.31 (max)	630.

ΔK (Ksi√in) da/dN (10<sup>-6</sup>in/cycle)

RMS %  
 Error  
 >100.0

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
 Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 5.11.3.1.3

Condition/Ht: 2100F 1HR SQ AT 1000F  
 Form: 1 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Stress Ratio: 0.05  
 Frequency: 0.3 Hz

Yield Strength: 176.1 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 in.  
 Specimen Width: 0.6 in.  
 Ref: GE001

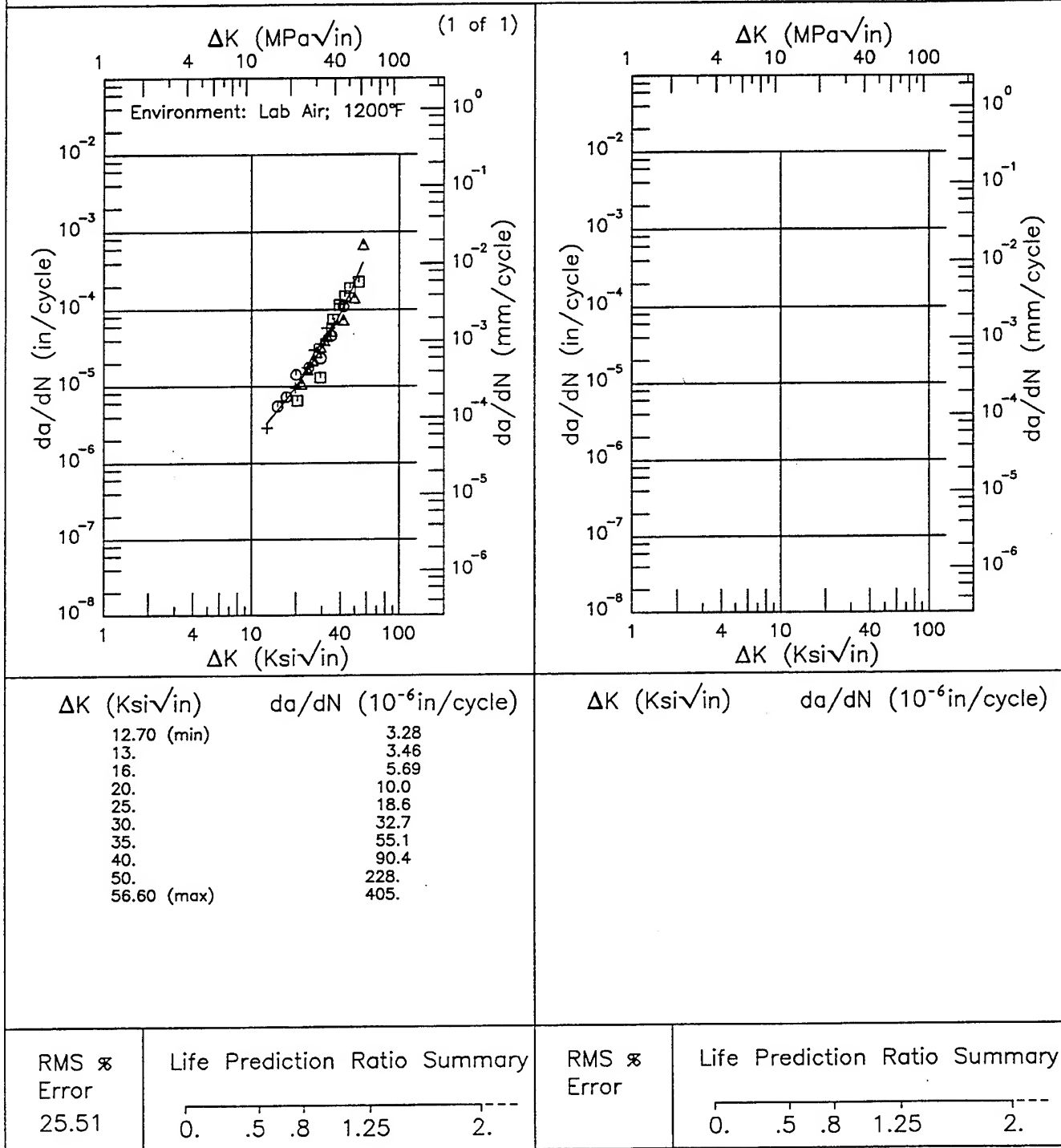
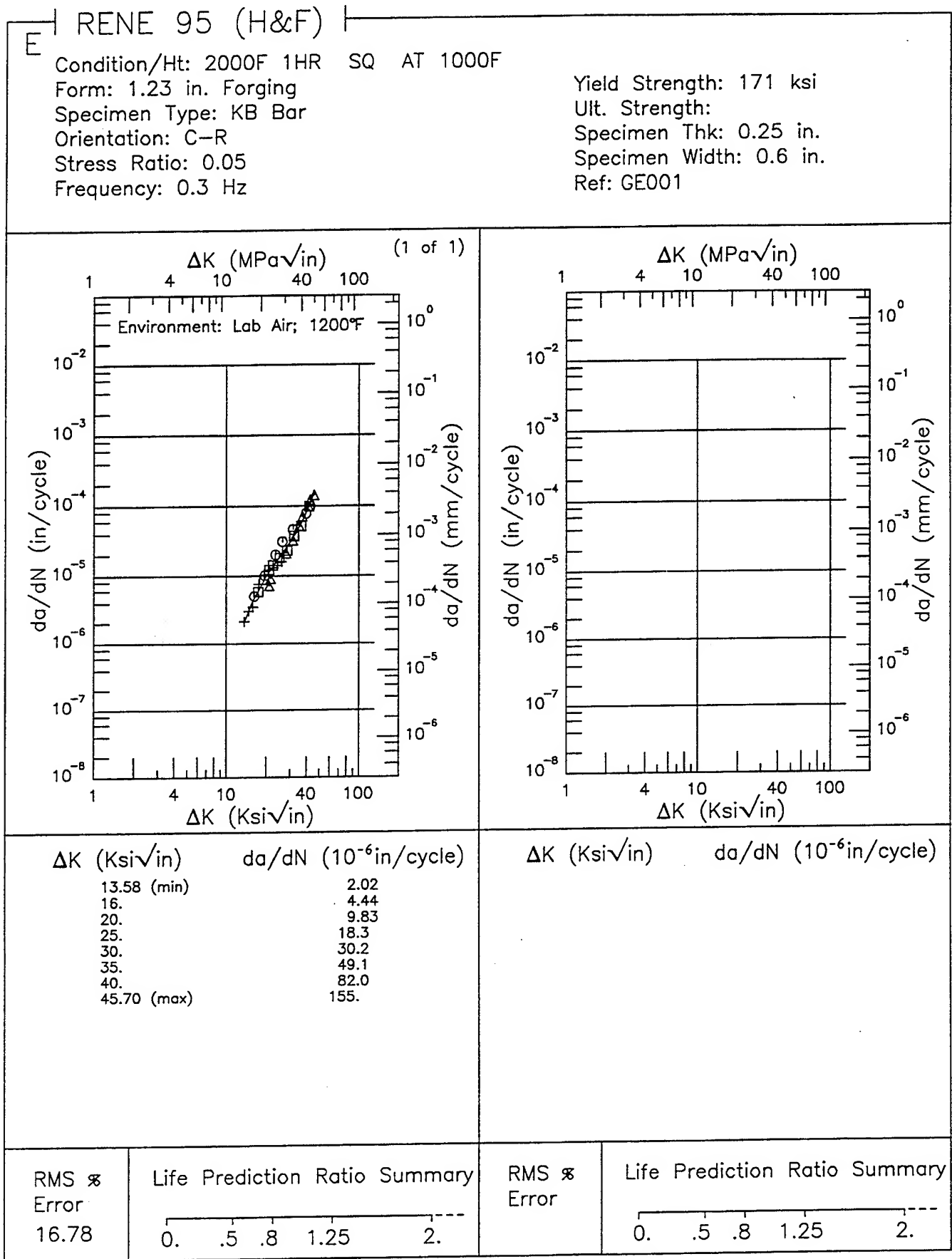


Figure 5.11.3.1.4



**Figure 5.12.3.1**

TABLE 5.13.1.2

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
WASPALLOY AT ROOM TEMPERATURE**

ORIENTATION: Unspecified		ENVIRONMENT: Lab Air							
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (ksi/in)					
				2.5	5.0	10.0	20.0	50.0	100.0
1850F 2HRS 1350F 6HRS	BILLET	0.1	10					10.46	
2010F 2HRS 1350F 6HRS	BILLET	0.1	10					2.8	
2010F 2HRS 1600F 24HRS	BILLET	0.1	10					9.56	

# WASPALLOY

E

Condition/Ht:

Form:

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.05

Frequency: 0.3 Hz

Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.25 - 0.452 in.

Specimen Width:

Ref: PW006

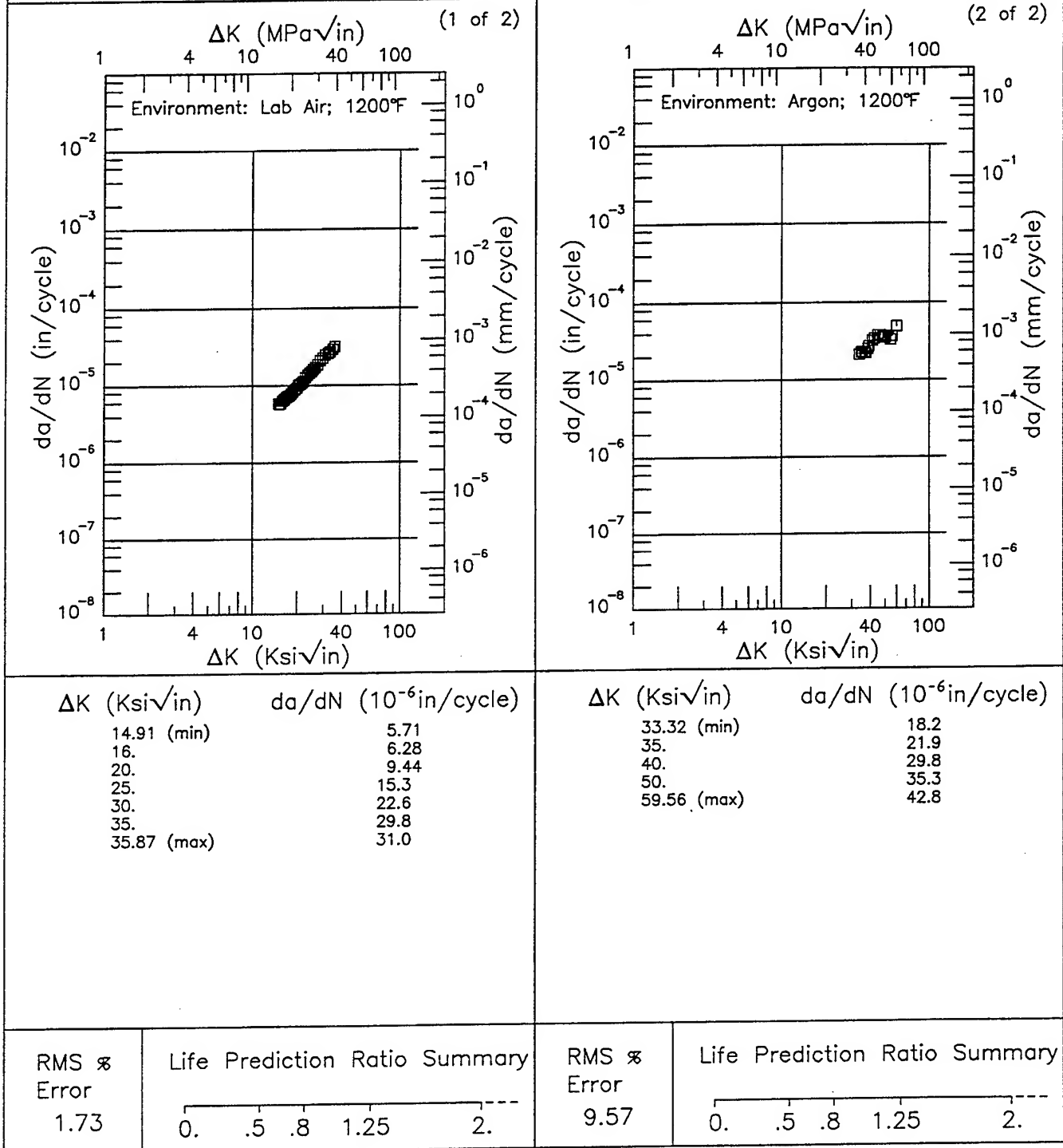


Figure 5.13.3.1.1

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CT

Orientation:

Stress Ratio: 0.05

Frequency: 20 Hz

Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.753 in.

Specimen Width: 2.505 in.

Ref: PW001

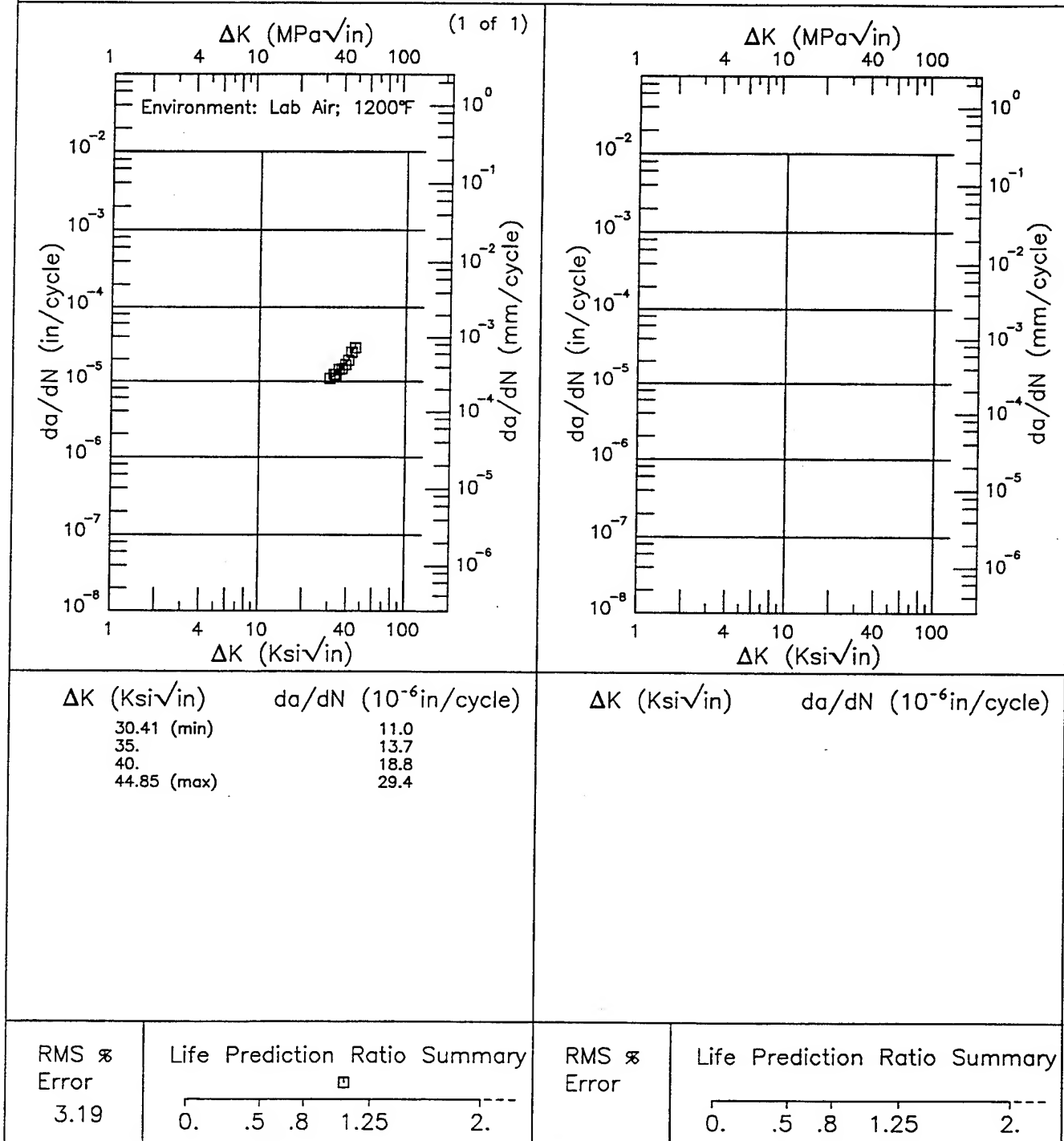
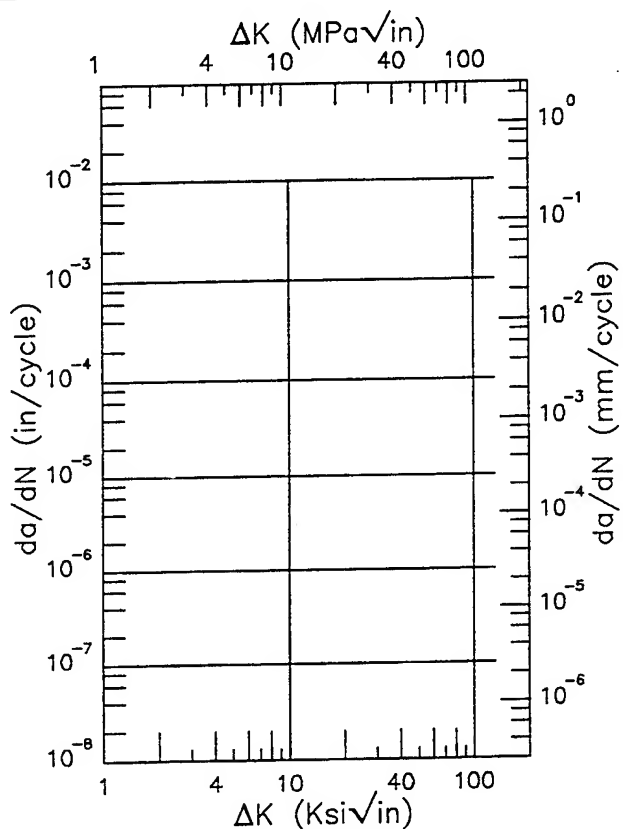
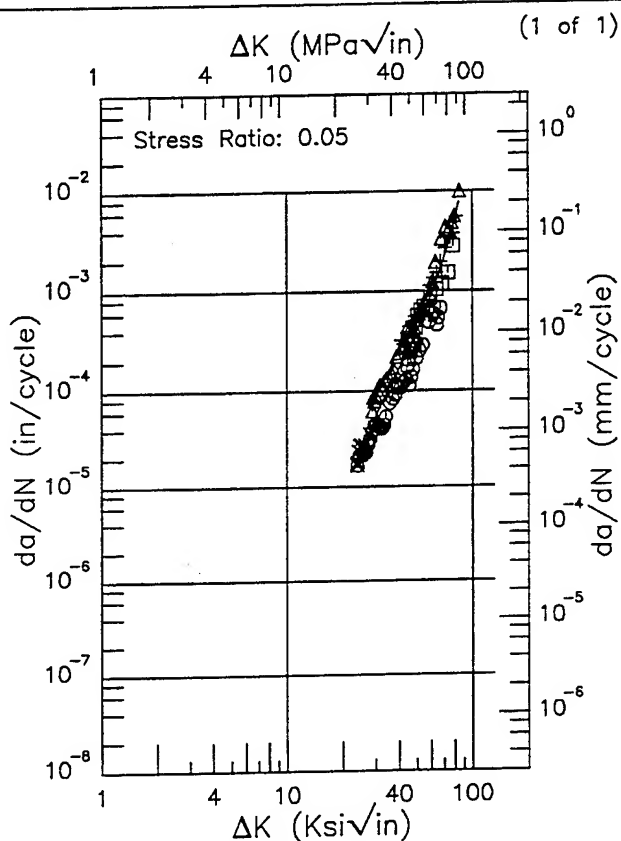


Figure 5.13.3.1.2

# WASPALLOY

Condition/Ht:  
Form: 1.6 in. Forging  
Specimen Type: CT  
Orientation: C-R  
Frequency:  
Environment: LAB AIR;1200°F

Yield Strength: 154 ksi  
Ult. Strength: 199.2 ksi  
Specimen Thk: 0.316 - 0.422 in.  
Specimen Width: 2.504 - 2.509 in.  
Ref: PW001



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
23.65 (min)	16.2
25.	22.3
30.	54.9
35.	103.
40.	170.
50.	394.
60.	885.
70.	2061.
80.	5074.
84.43 (max)	7701.

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$ in/cycle)

RMS %  
Error  
38.52

Life Prediction Ratio Summary

○ □ × ▲

0. .5 .8 1.25 2.

RMS %  
Error

Life Prediction Ratio Summary

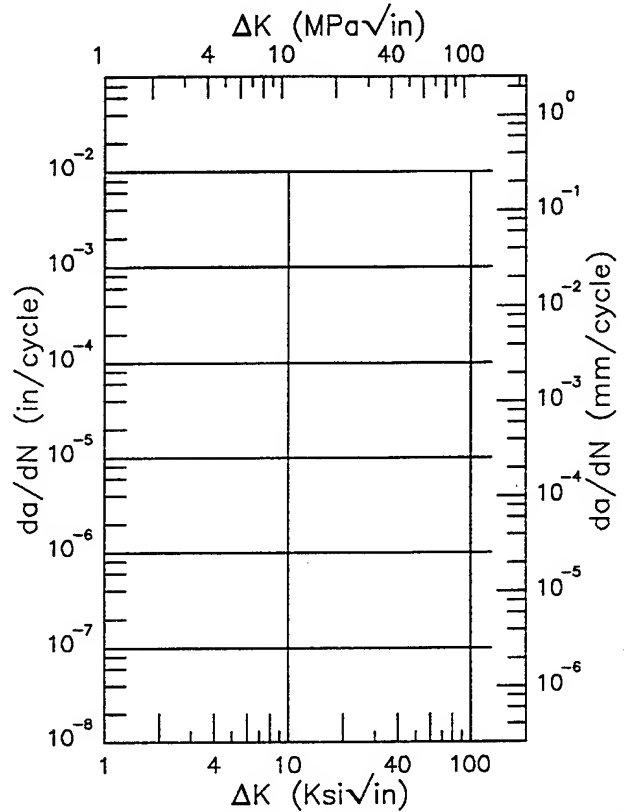
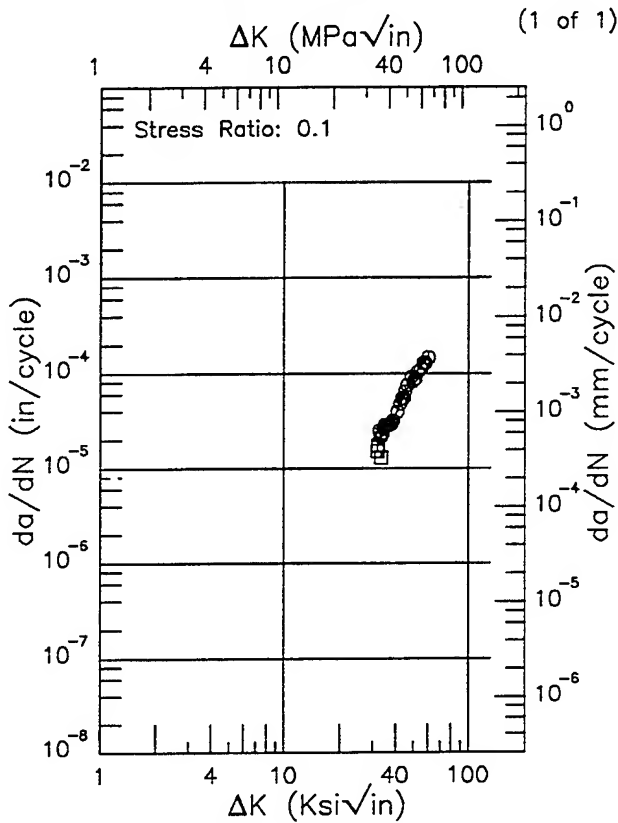
0. .5 .8 1.25 2.

Figure 5.13.3.1.3



Condition/Ht:  
 Form: 1.6 in. Forging  
 Specimen Type: CT  
 Orientation: C-R  
 Frequency:  
 Environment: LAB AIR;1350°F

Yield Strength: 154 ksi  
 Ult. Strength: 199.2 ksi  
 Specimen Thk: 0.299 - 0.3 in.  
 Specimen Width: 2.504 - 2.511 in.  
 Ref: PW001



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
31.69 (min)	17.6
35.	25.5
40.	37.6
50.	93.8
60.	150.
60.02 (max)	150.

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
-------------	-----------------------------------

RMS %  
 Error  
 11.82

Life Prediction Ratio Summary

□ ○

0. .5 .8 1.25 2.

RMS %  
 Error

Life Prediction Ratio Summary

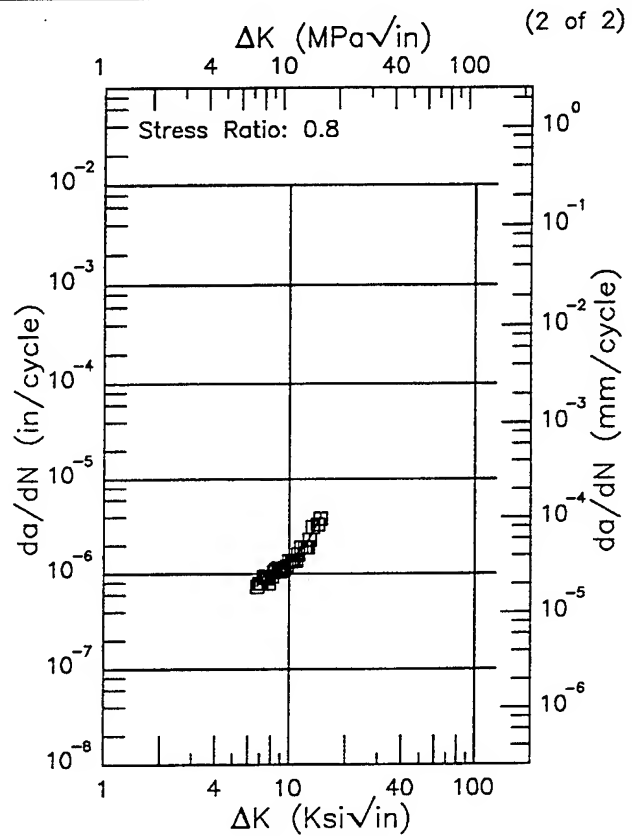
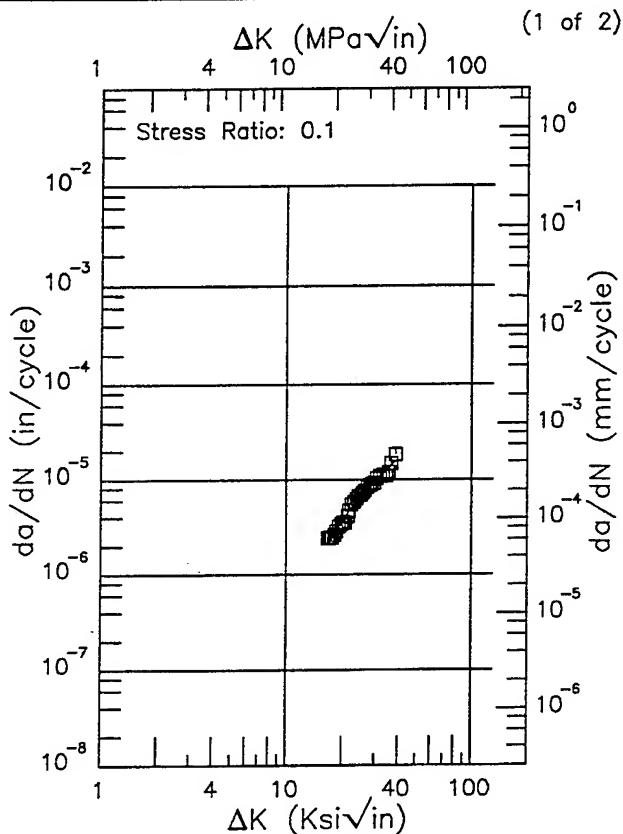
0. .5 .8 1.25 2.

Figure 5.13.3.1.4

# WASPALLOY

Condition/Ht:  
 Form: 1.6 in. Forging  
 Specimen Type: CT  
 Orientation: C-R  
 Frequency: 20 Hz  
 Environment: LAB AIR;1200°F

Yield Strength: 154 ksi  
 Ult. Strength: 199.2 ksi  
 Specimen Thk: 0.3 - 0.302 in.  
 Specimen Width: 2.503 - 2.518 in.  
 Ref: PW001



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
16.66 (min)	2.04
20.	3.73
25.	6.59
30.	9.62
35.	13.0
38.72 (max)	15.8

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
6.75 (min)	0.761
7.	0.801
8.	0.947
9.	1.10
10.	1.28
13.	2.43
14.64 (max)	3.92

RMS %  
 Error  
 7.34

Life Prediction Ratio Summary

RMS %  
 Error  
 7.28

Life Prediction Ratio Summary

Figure 5.13.3.1.5

**This page intentionally left blank**

# WASPALLOY

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.05

Frequency: 0.2 Hz

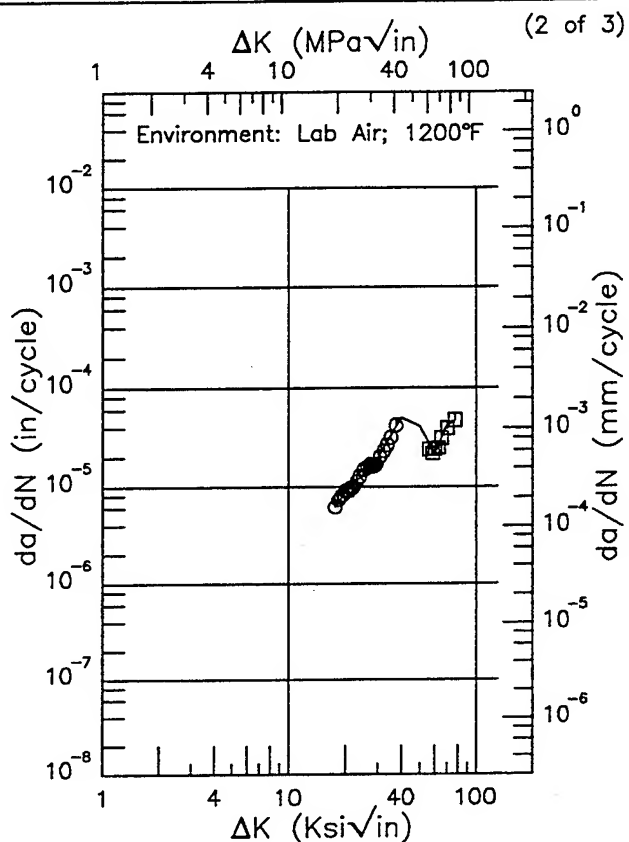
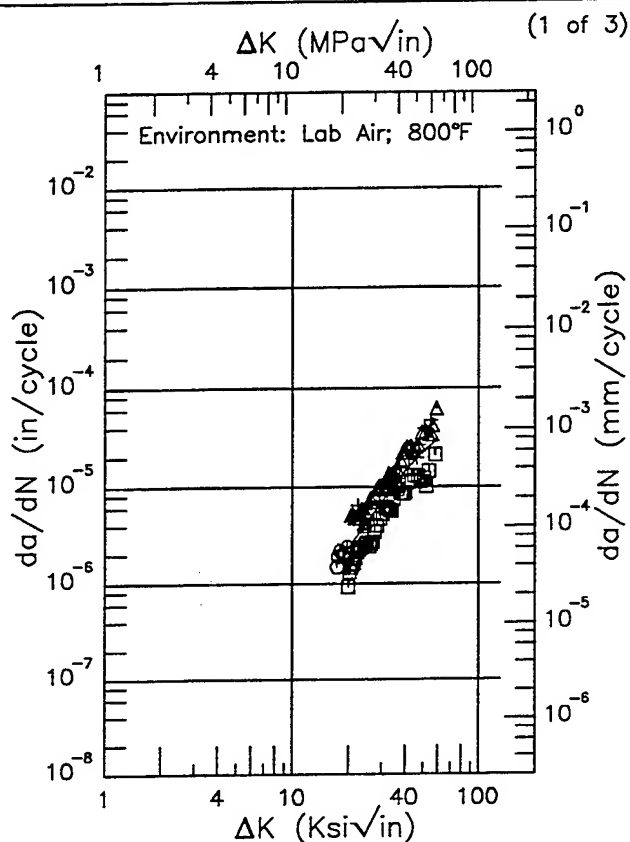
Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.102 - 0.501 in.

Specimen Width: 2.486 - 2.519 in.

Ref: PW001



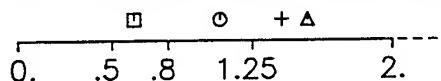
$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
17.25 (min)	1.57
20.	2.32
25.	4.28
30.	7.01
35.	10.4
40.	14.4
50.	22.8
58.47 (max)	29.4

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
17.60 (min)	6.24
20.	8.79
25.	13.3
30.	19.6
35.	32.5
40.	50.4
50.	41.3
60.	21.8
70.	42.1
76.85 (max)	45.9

RMS %  
Error

44.49

Life Prediction Ratio Summary



RMS %  
Error

5.85

Life Prediction Ratio Summary

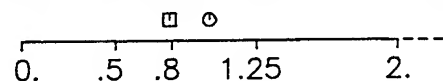


Figure 5.13.3.1.6

Condition/Ht:  
 Form: 1.6 in. Forging  
 Specimen Type: CT  
 Orientation: C-R  
 Stress Ratio: 0.05  
 Frequency: 0.2 Hz

Yield Strength: 154 ksi  
 Ult. Strength: 199.2 ksi  
 Specimen Thk: 0.102 - 0.501 in.  
 Specimen Width: 2.486 - 2.519 in.  
 Ref: PW001

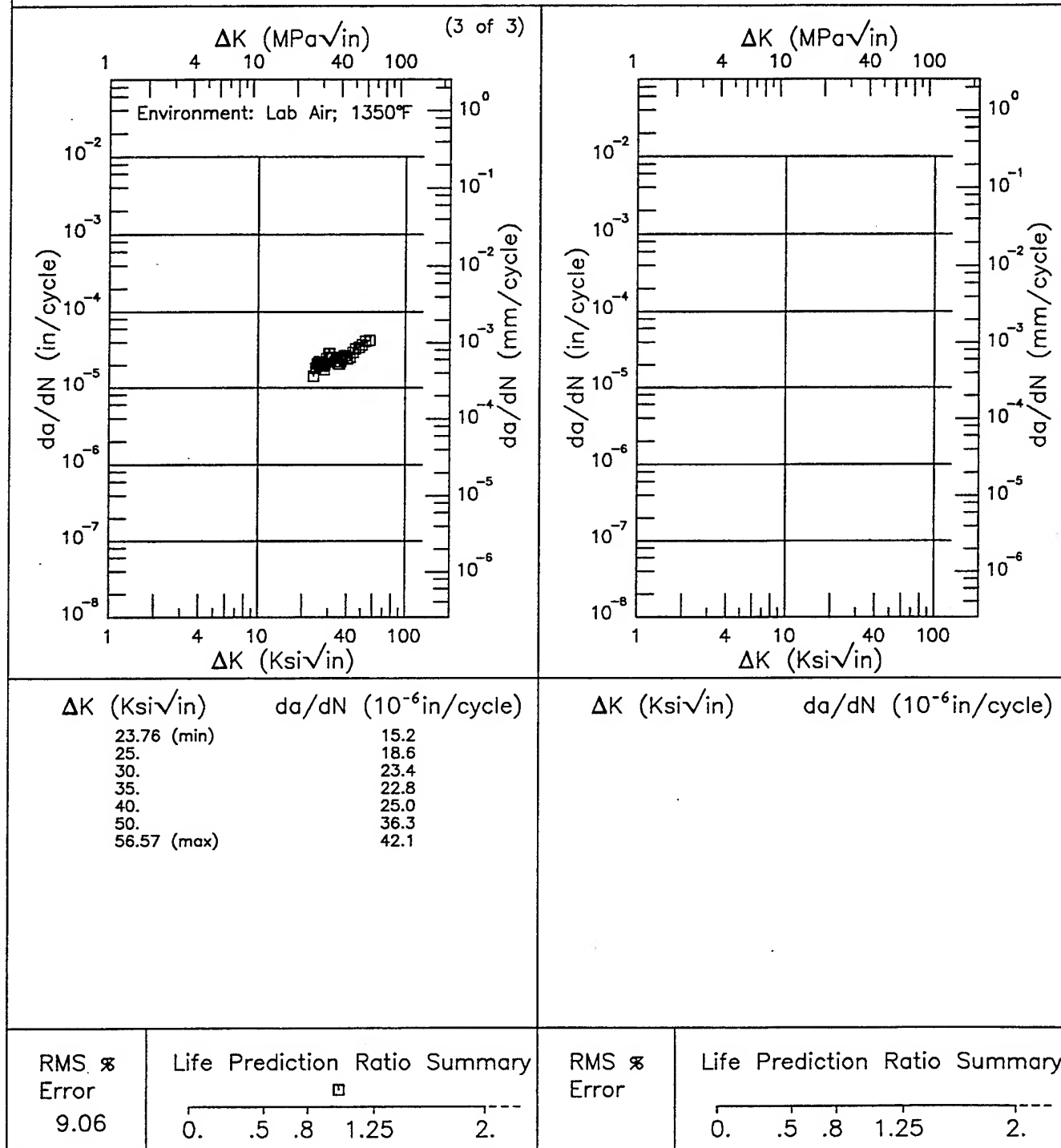


Figure 5.13.3.1.6 (Concluded)

# WASPALLOY

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.1

Frequency: 20 Hz

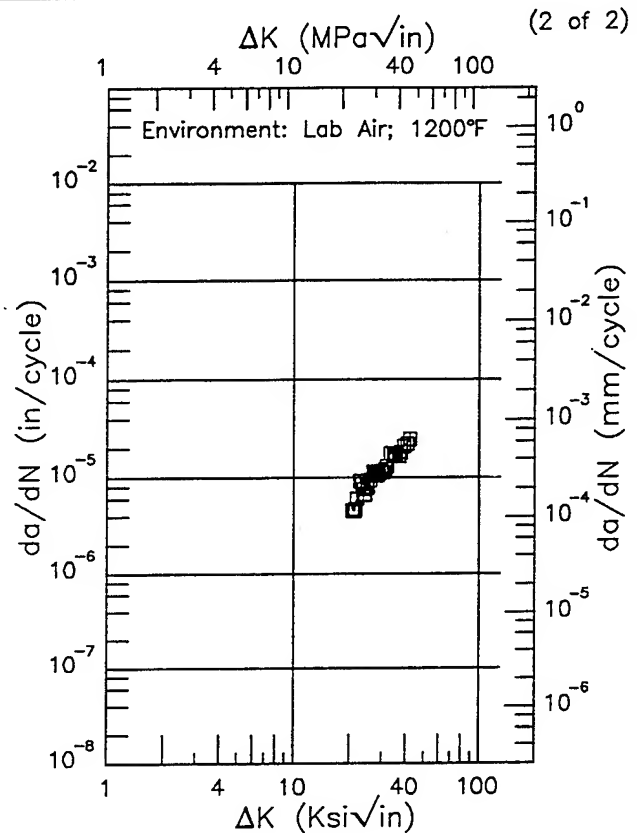
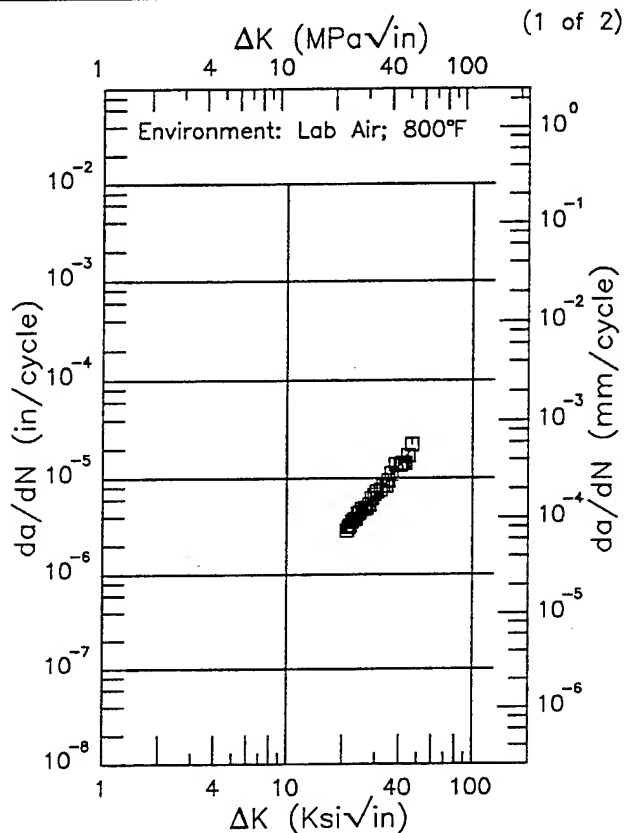
Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.307 - 0.5 in.

Specimen Width: 2.508 - 2.51 in.

Ref: PW001



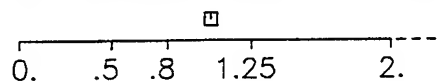
$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ (10 <sup>-6</sup> in/cycle)
20.94 (min)	2.96
25.	4.45
30.	6.72
35.	9.60
40.	13.3
46.62 (max)	19.9

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ (10 <sup>-6</sup> in/cycle)
20.71 (min)	4.85
25.	8.72
30.	12.5
35.	16.2
40.	21.5
42.08 (max)	24.6

RMS %  
Error

5.34

Life Prediction Ratio Summary



RMS %  
Error

11.97

Life Prediction Ratio Summary

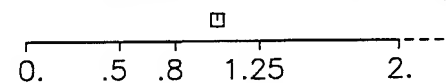


Figure 5.13.3.1.7

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.05

Environment: LAB AIR; 1200°F

Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.432 - 0.447 in.

Specimen Width: 2.502 - 2.503 in.

Ref: PW001

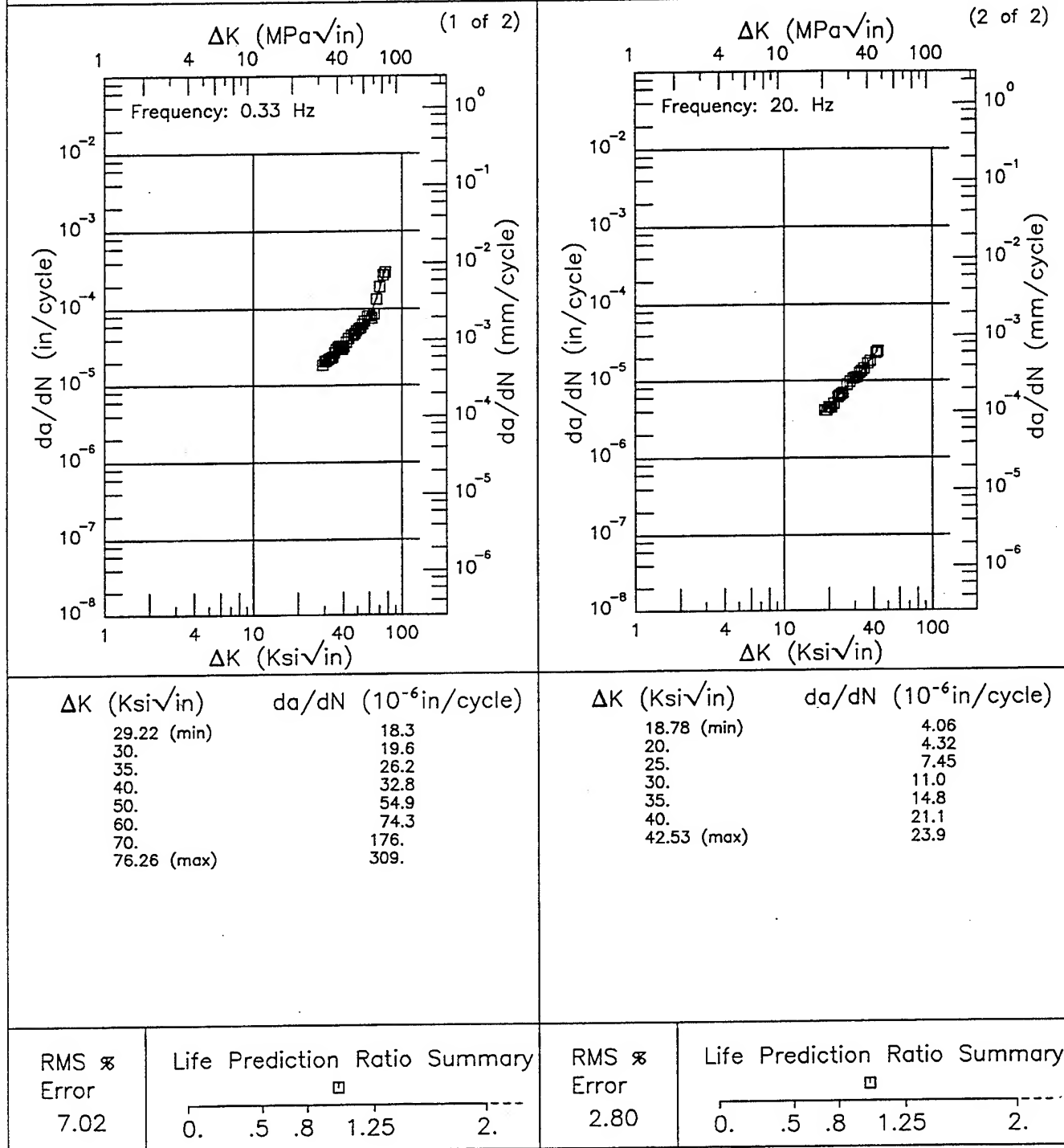
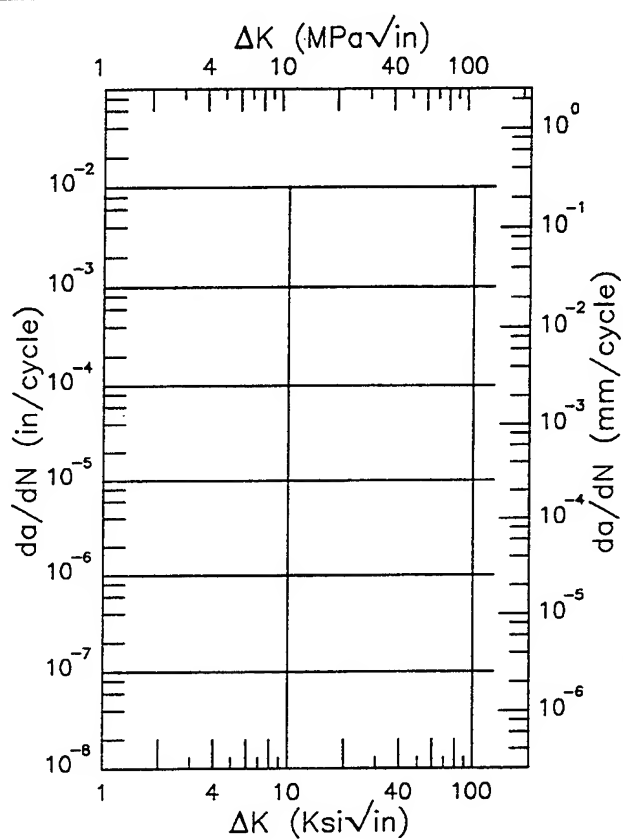
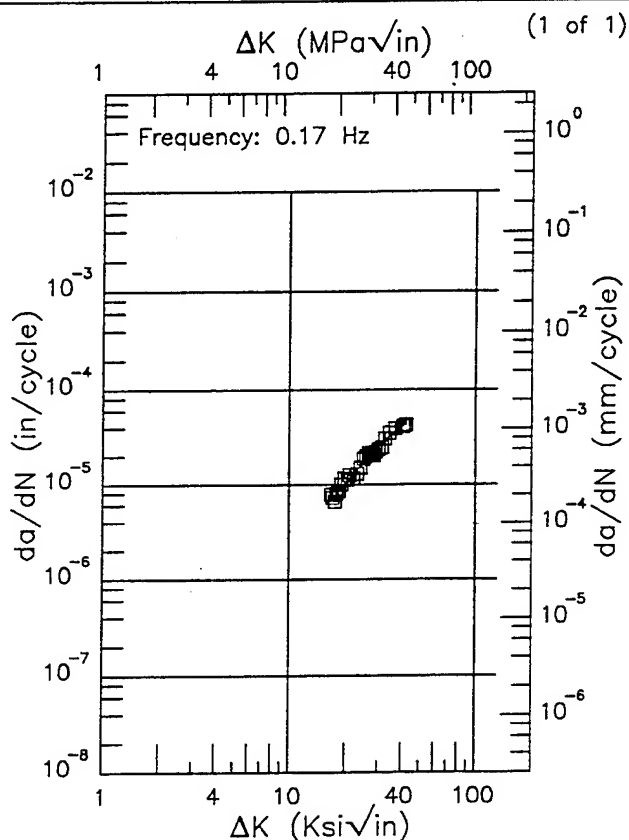


Figure 5.13.3.1.8

# WASPALLOY

Condition/Ht:  
 Form: 1.6 in. Forging  
 Specimen Type: CT  
 Orientation: C-R  
 Stress Ratio: 0.1  
 Environment: LAB AIR;1200°F

Yield Strength: 154 ksi  
 Ult. Strength: 199.2 ksi  
 Specimen Thk: 0.318 in.  
 Specimen Width: 2.484 in.  
 Ref: PW001



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
16.71 (min)	7.03
20.	10.4
25.	17.1
30.	25.1
35.	33.6
40.	41.5
42.17 (max)	44.6

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS  $\times$   
 Error  
 8.10

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

RMS  $\times$   
 Error

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

**Figure 5.13.3.1.9**



Condition/Ht:  
 Form: 1.6 in. Forging  
 Specimen Type: CCP (max load specified)  
 Orientation:  
 Frequency: 0.2 Hz  
 Environment: LAB AIR;1200°F

Yield Strength: 154 ksi  
 Ult. Strength: 199.2 ksi  
 Specimen Thk: 0.287 - 0.297 in.  
 Specimen Width: 0.973 - 0.998 in.  
 Ref: PW001

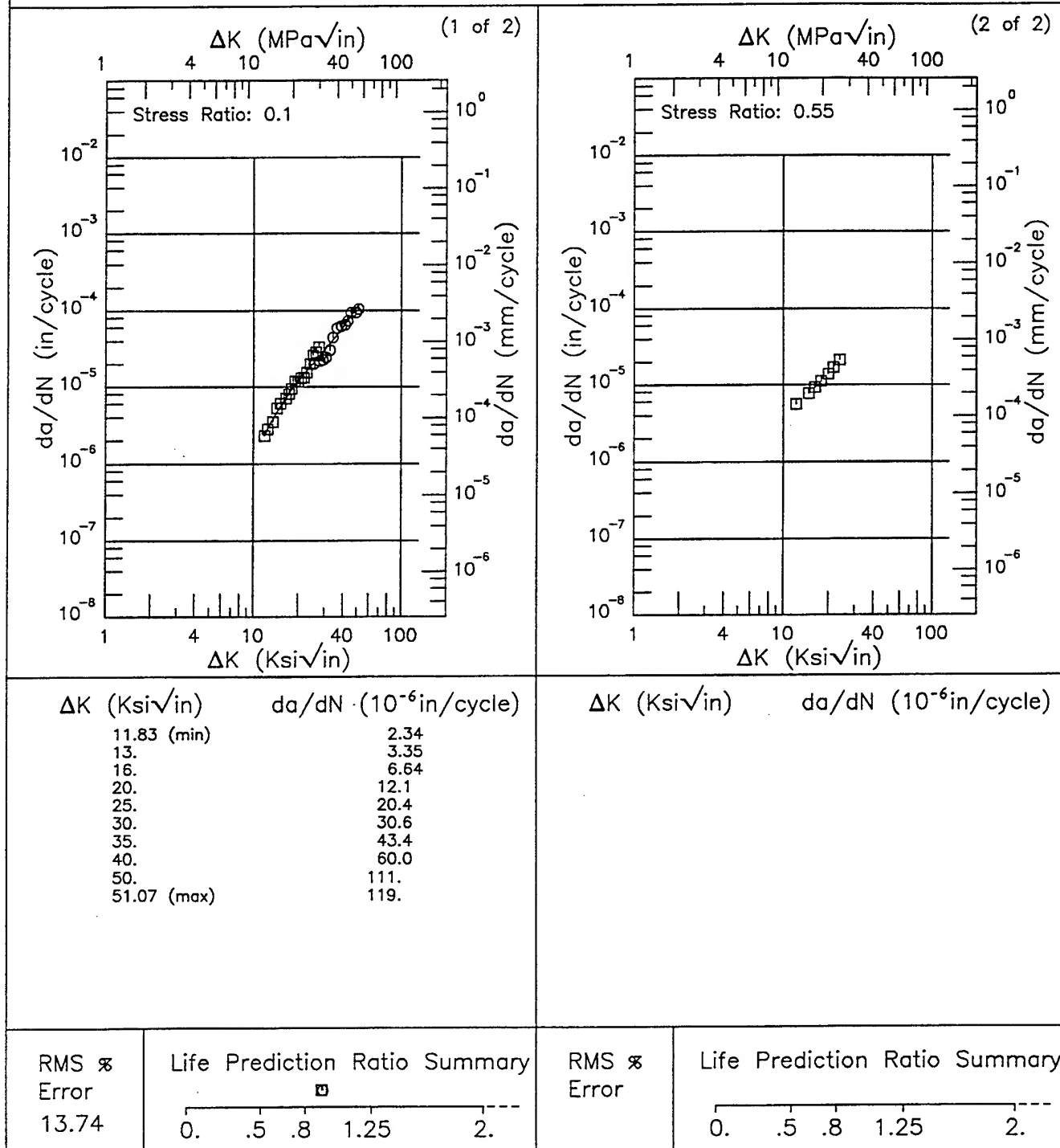


Figure 5.13.3.1.10

# WASPALLOY

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CCP (max load specified)

Orientation:

Stress Ratio: -1

Frequency: 0.2 Hz

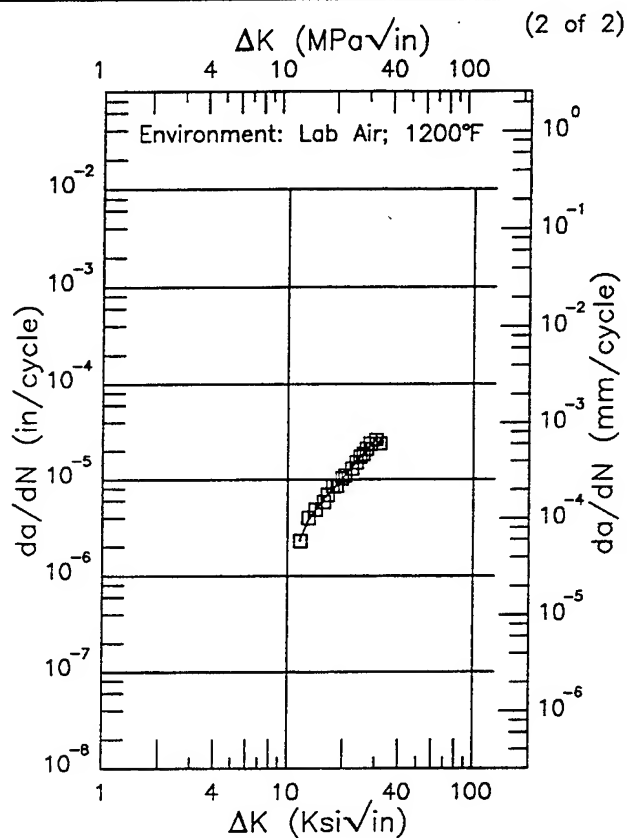
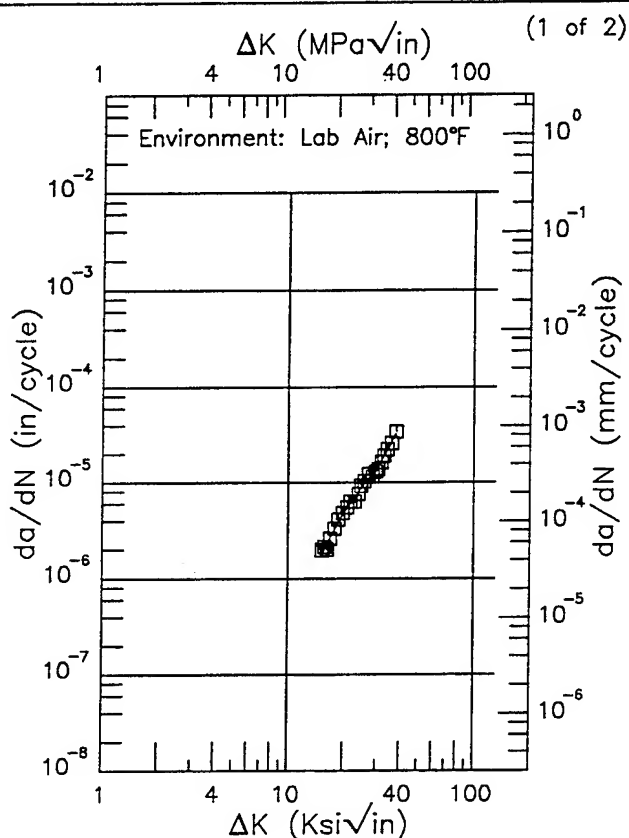
Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.297 - 0.3 in.

Specimen Width: 0.997 in.

Ref: PW001



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ (10 <sup>-6</sup> in/cycle)
15.16 (min)	1.74
16.	2.18
20.	4.80
25.	9.05
30.	13.7
35.	23.6
37.90 (max)	32.6

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ (10 <sup>-6</sup> in/cycle)
11.63 (min)	2.32
13.	3.84
16.	6.44
20.	10.5
25.	17.3
30.	25.8
31.47 (max)	23.4

RMS %  
Error  
6.56

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

RMS %  
Error  
3.61

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

Figure 5.13.3.1.11

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CCP (max load specified)

Orientation:

Stress Ratio: -0.5

Frequency: 0.2 Hz

Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.298 in.

Specimen Width: 0.996 - 0.998 in.

Ref: PW001

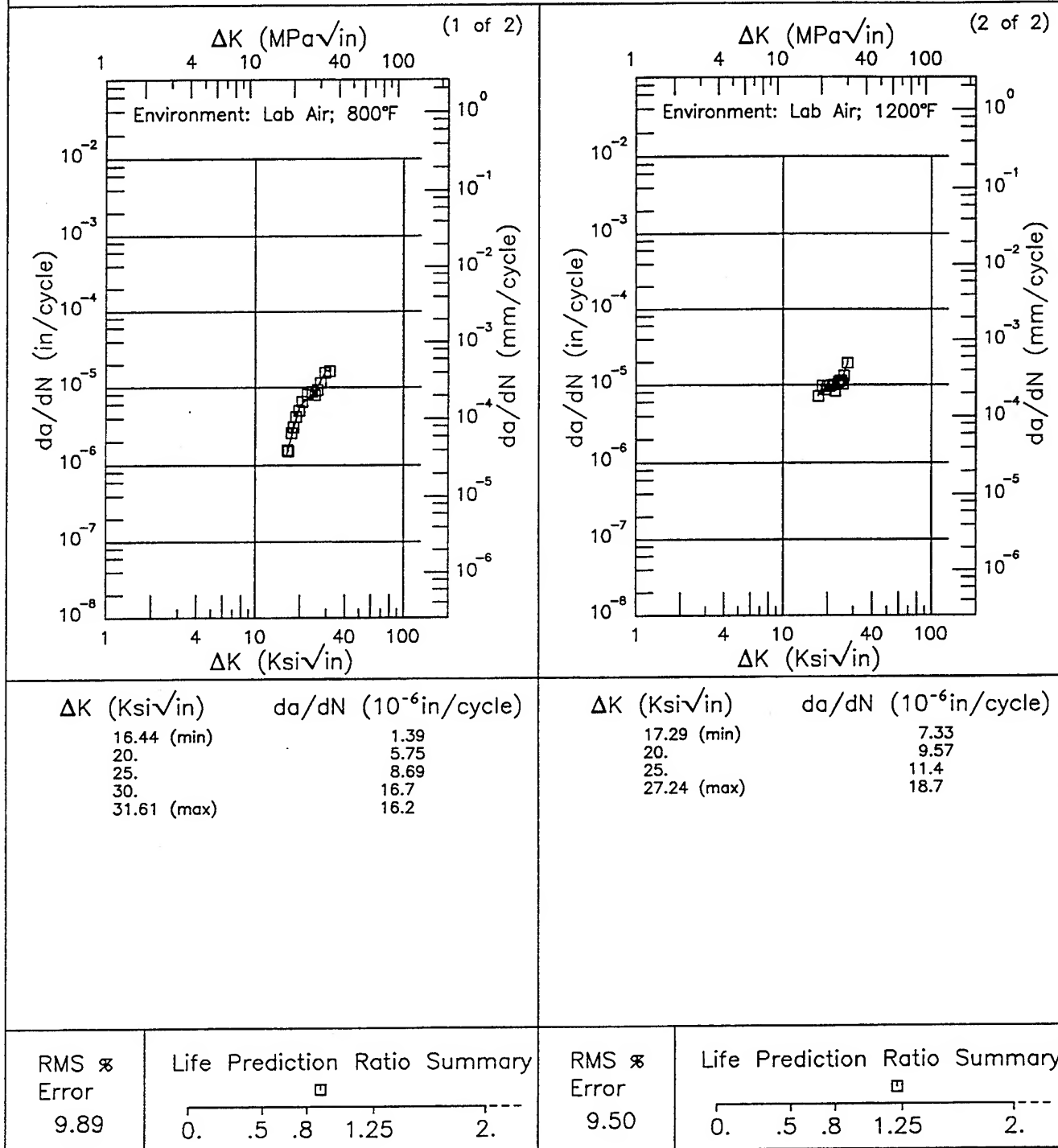


Figure 5.13.3.1.12

# WASPALLOY

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CCP (max load specified)

Orientation:

Stress Ratio: 0.05

Frequency: 0.2 Hz

Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.301 - 0.303 in.

Specimen Width: 0.996 - 0.998 in.

Ref: PW001

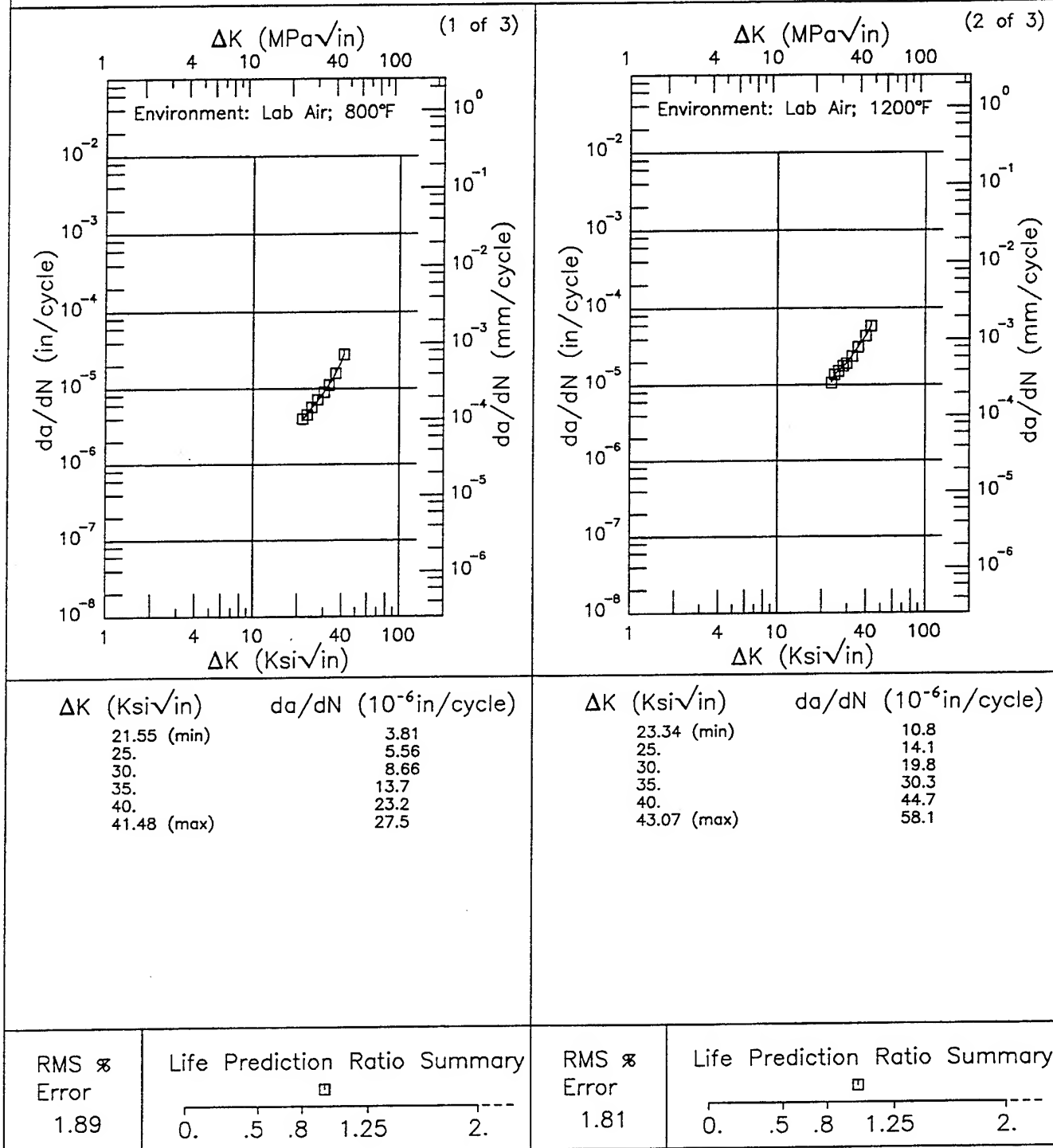


Figure 5.13.3.1.13

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CCP (max load specified)

Orientation:

Stress Ratio: 0.05

Frequency: 0.2 Hz

Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.301 – 0.303 in.

Specimen Width: 0.996 – 0.998 in.

Ref: PW001

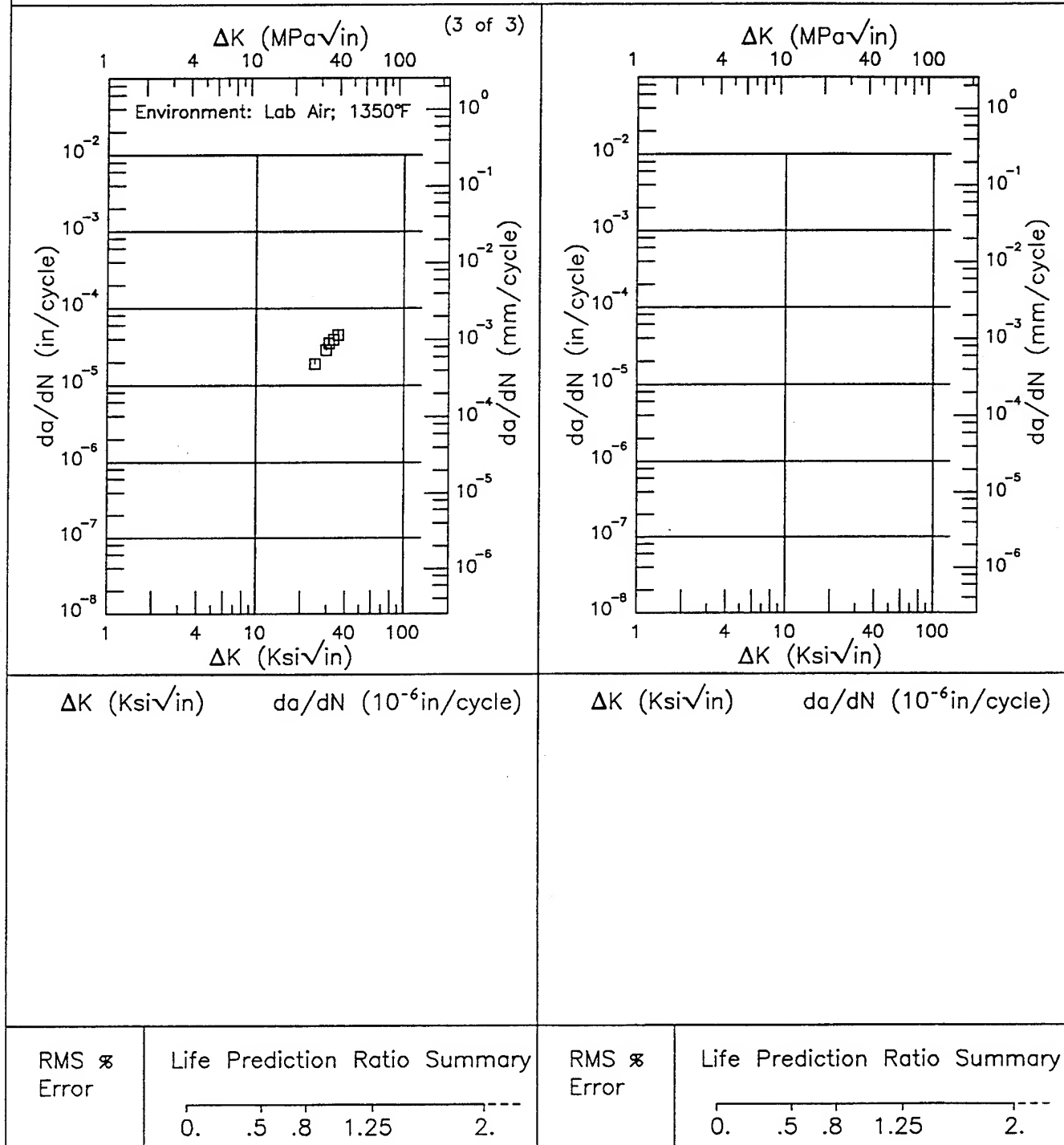


Figure 5.13.3.1.13 (Concluded)

# WASPALLOY

E

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CCP (max load specified)

Orientation:

Stress Ratio: 0.5

Frequency: 0.2 Hz

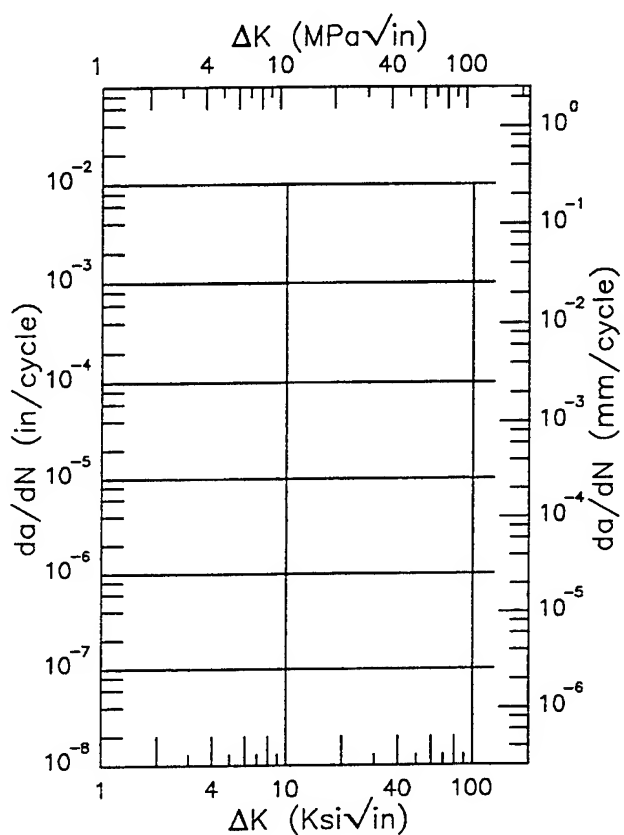
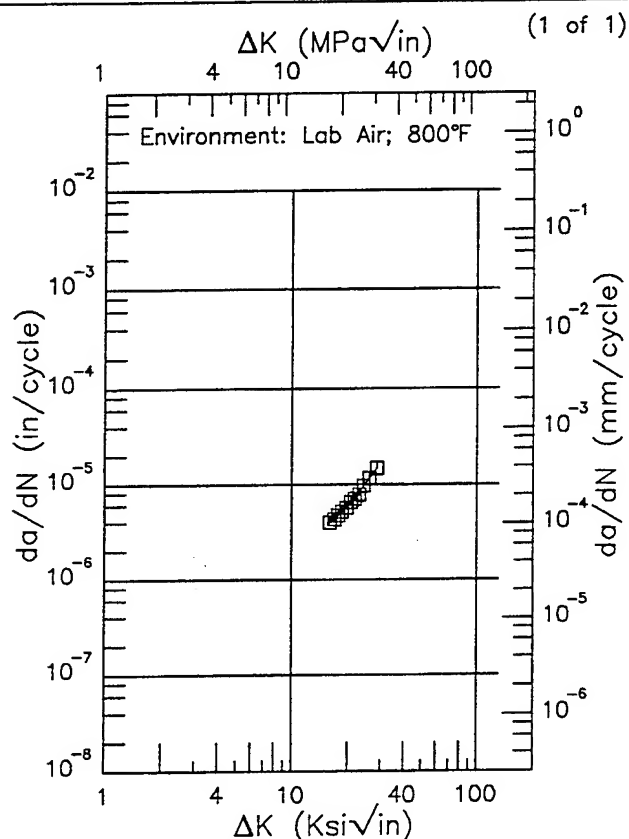
Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.3 in.

Specimen Width: 0.995 in.

Ref: PW001



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ (10 <sup>-6</sup> in/cycle)
15.92 (min)	3.88
16.	3.92
20.	5.91
25.	10.4
28.39 (max)	14.6

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ (10 <sup>-6</sup> in/cycle)
--------------------------------------	-------------------------------------

RMS %  
Error  
1.98

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

Figure 5.13.3.1.14

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CCP (max load specified)

Orientation:

Stress Ratio: 0.8

Frequency: 0.2 Hz

Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.3 in.

Specimen Width: 0.996 – 0.998 in.

Ref: PW001

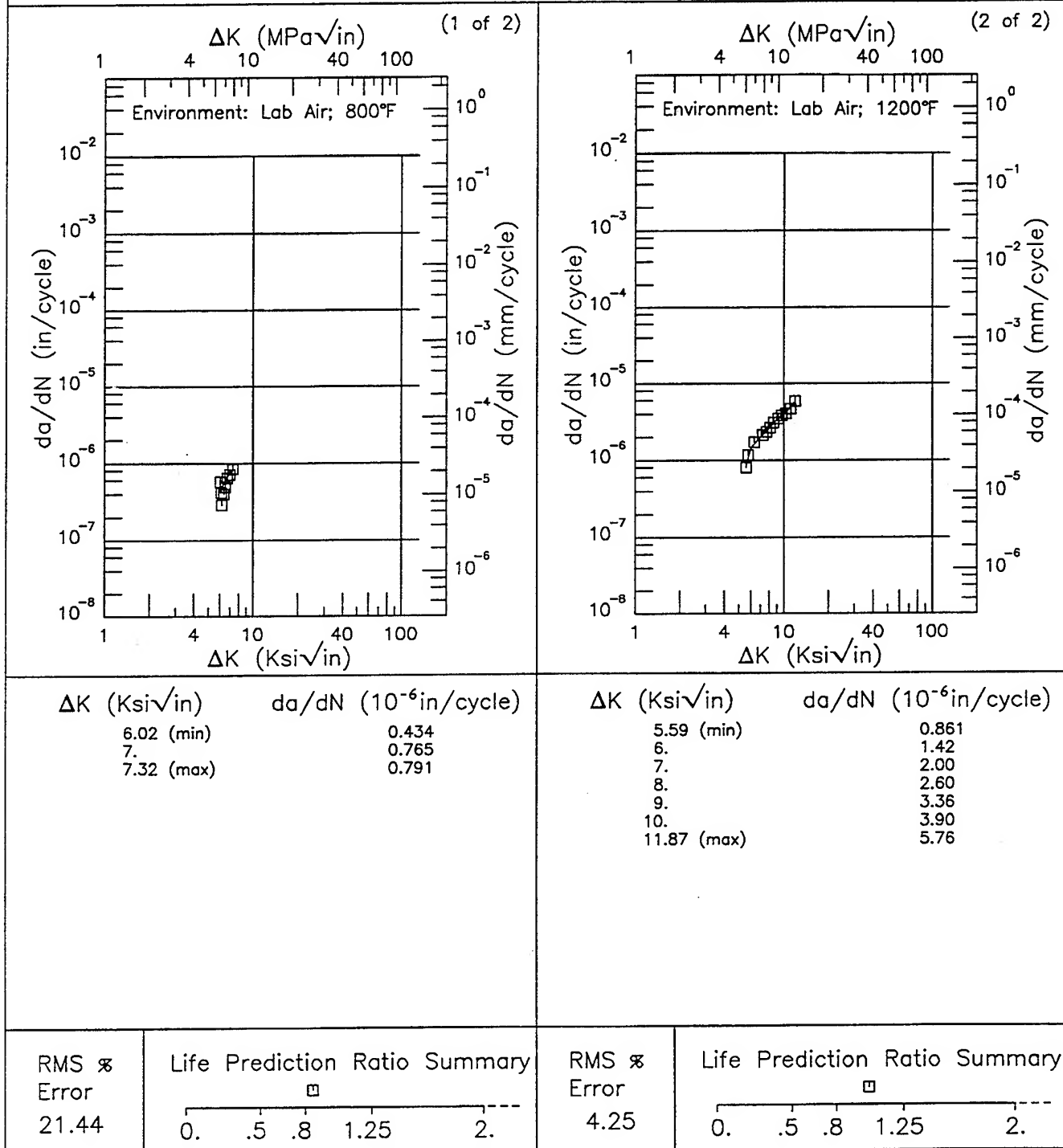


Figure 5.13.3.1.15

# WASPALLOY

Condition/Ht:

Form: 1.6 in. Forging

Specimen Type: CCP (max load specified)

Orientation: C-R

Stress Ratio: 0.1

Frequency: 0. Hz

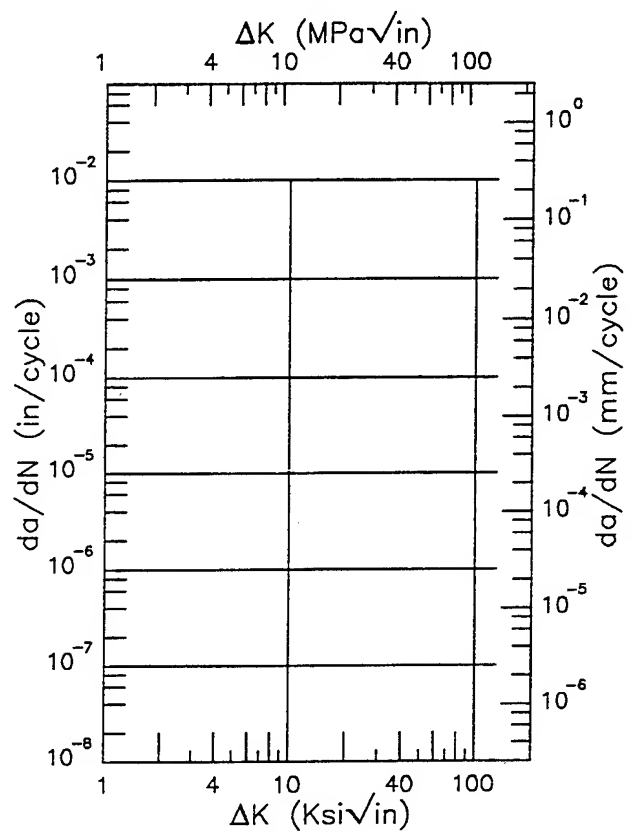
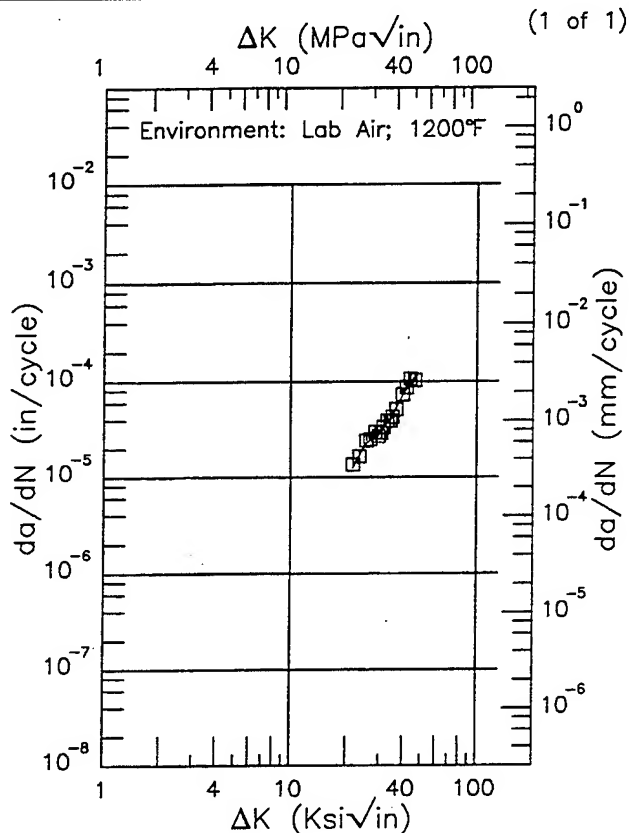
Yield Strength: 154 ksi

Ult. Strength: 199.2 ksi

Specimen Thk: 0.299 in.

Specimen Width: 0.998 in.

Ref: PW001



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
21.41 (min)	12.5
25.	22.2
30.	30.0
35.	44.3
40.	75.4
45.95 (max)	109.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
--------------------------------------	-----------------------------------

RMS %  
Error  
5.56

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

**Figure 5.13.3.1.16**



Condition/Ht: 1850F 2HRS 1350F 6HRS  
 Form: 1.18 in. Billet  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.1  
 Frequency: 10 Hz

Yield Strength: 145 ksi  
 Ult. Strength: 249 ksi  
 Specimen Thk: 0.125 in.  
 Specimen Width: 1.25 in.  
 Ref: UC001

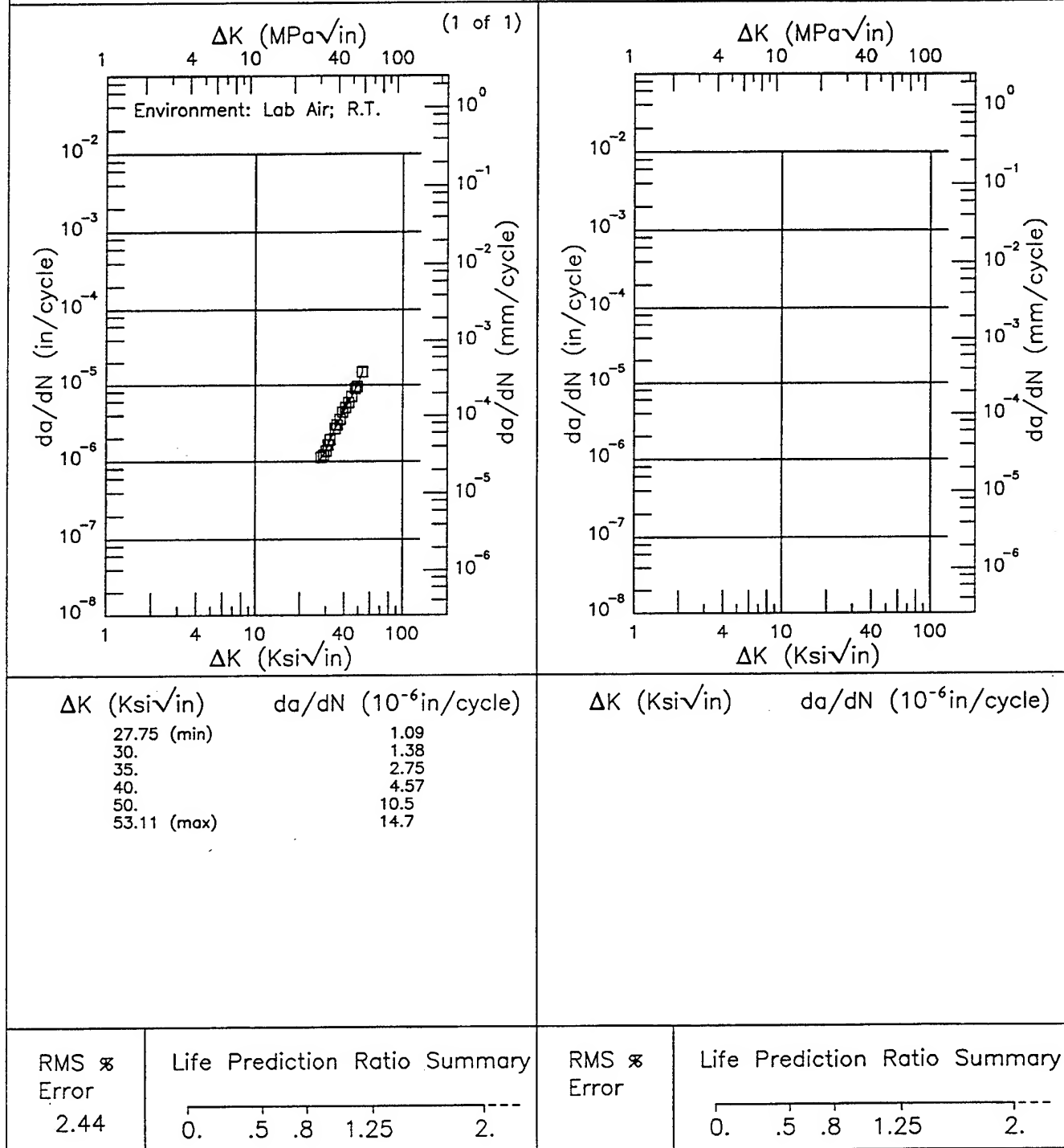
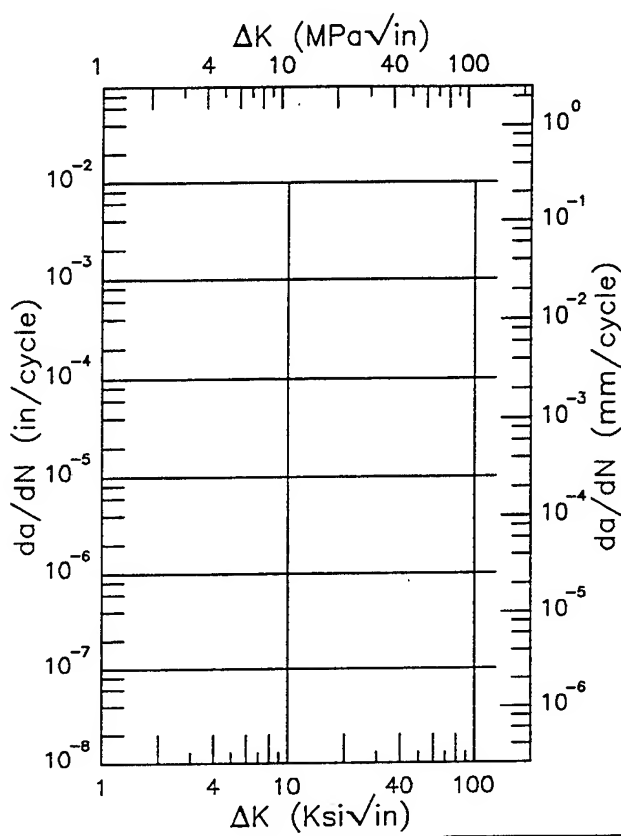
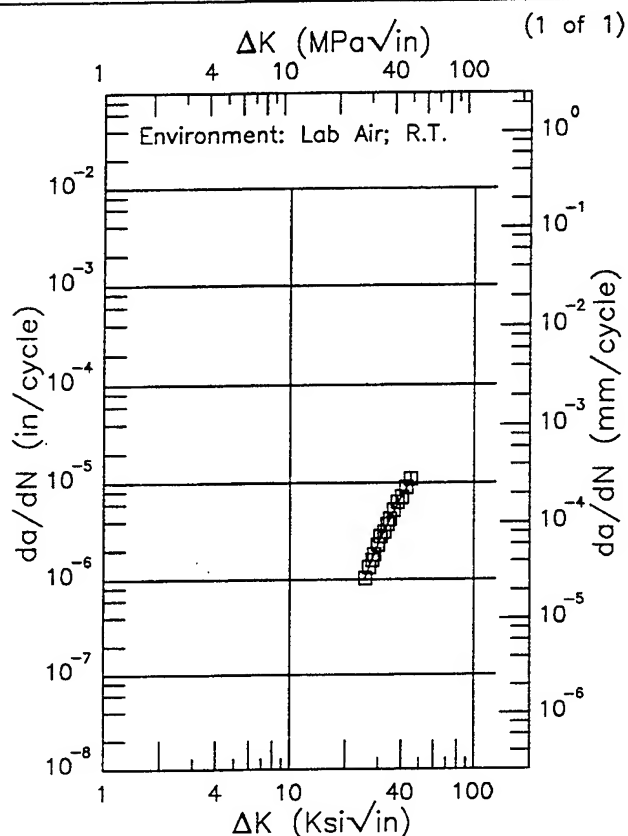


Figure 5.13.3.1.17

# WASPALLOY

Condition/Ht: 1850F 2HRS 1600F 24HRS (FINE GS)  
 Form: 1.18 in. Billet  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.1  
 Frequency: 10 Hz

Yield Strength: 111.5 ksi  
 Ult. Strength: 228 ksi  
 Specimen Thk: 0.125 in.  
 Specimen Width: 1.25 in.  
 Ref: UC001



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
25.47 (min)	1.03
30.	2.33
35.	4.39
40.	7.13
45.09 (max)	10.9

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
--------------------------------------	-------------------------------

RMS  $\times$   
 Error  
 2.60

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2.

RMS  $\times$   
 Error

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2.

Figure 5.13.3.1.18

**This page intentionally left blank**

F

## WASPALLOY

Condition/Ht: 1875F 4HRS OQ 1550F 4HRS AC

Form: Disk

Specimen Type: WOL

Orientation: C-R

Stress Ratio: 0.05

Environment: LAB AIR;1200°F

Yield Strength: 153.7 ksi

Ult. Strength: 199.7 ksi

Specimen Thk: 0.5 in.

Specimen Width: 2.5 in.

Ref: PW004

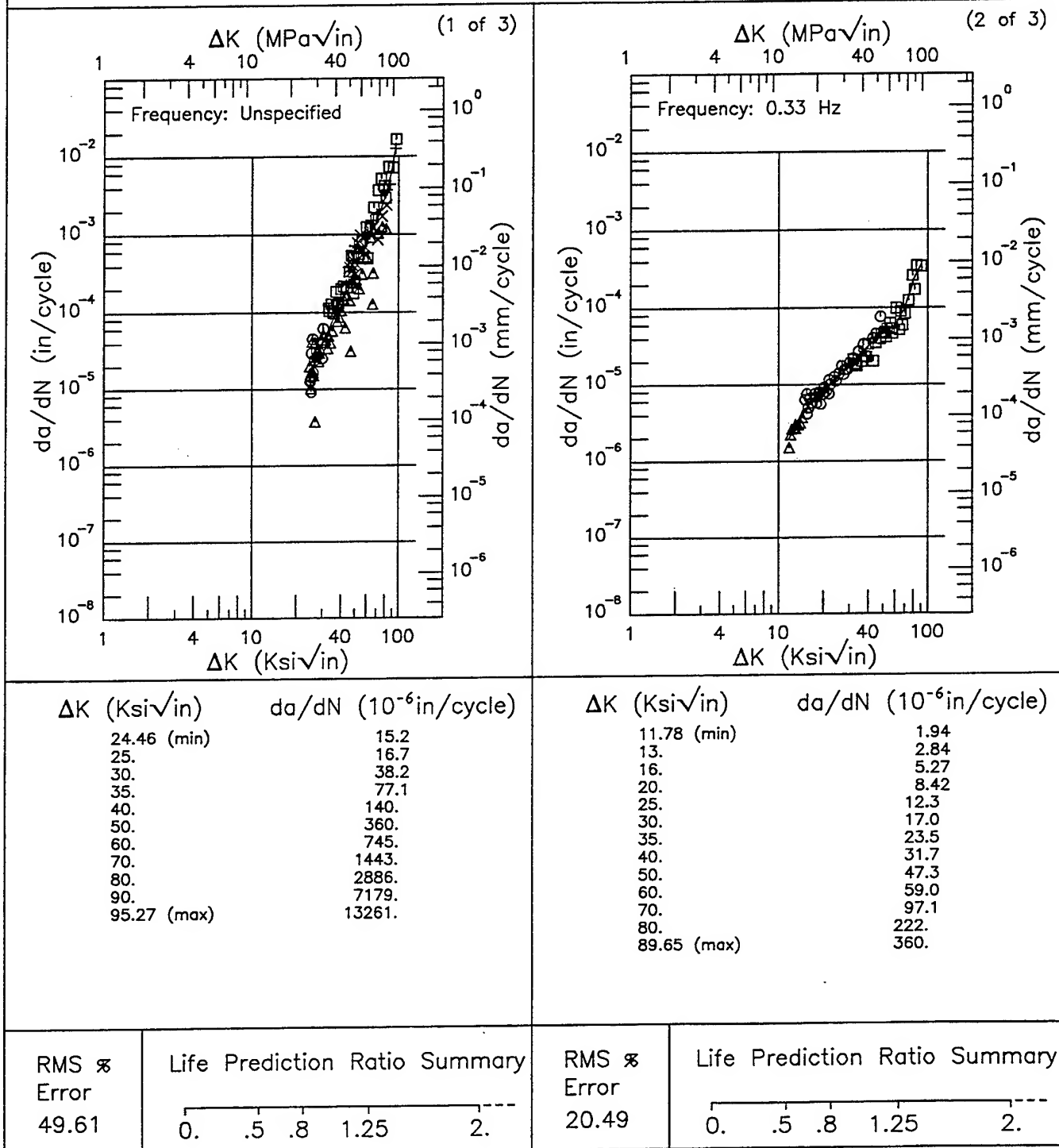


Figure 5.13.3.1.19

Condition/Ht: 1875F 4HRS OQ 1550F 4HRS AC

Form: Disk

Specimen Type: WOL

Orientation: C-R

Stress Ratio: 0.05

Environment: LAB AIR;1200°F

Yield Strength: 153.7 ksi

Ult. Strength: 199.7 ksi

Specimen Thk: 0.5 in.

Specimen Width: 2.5 in.

Ref: PW004

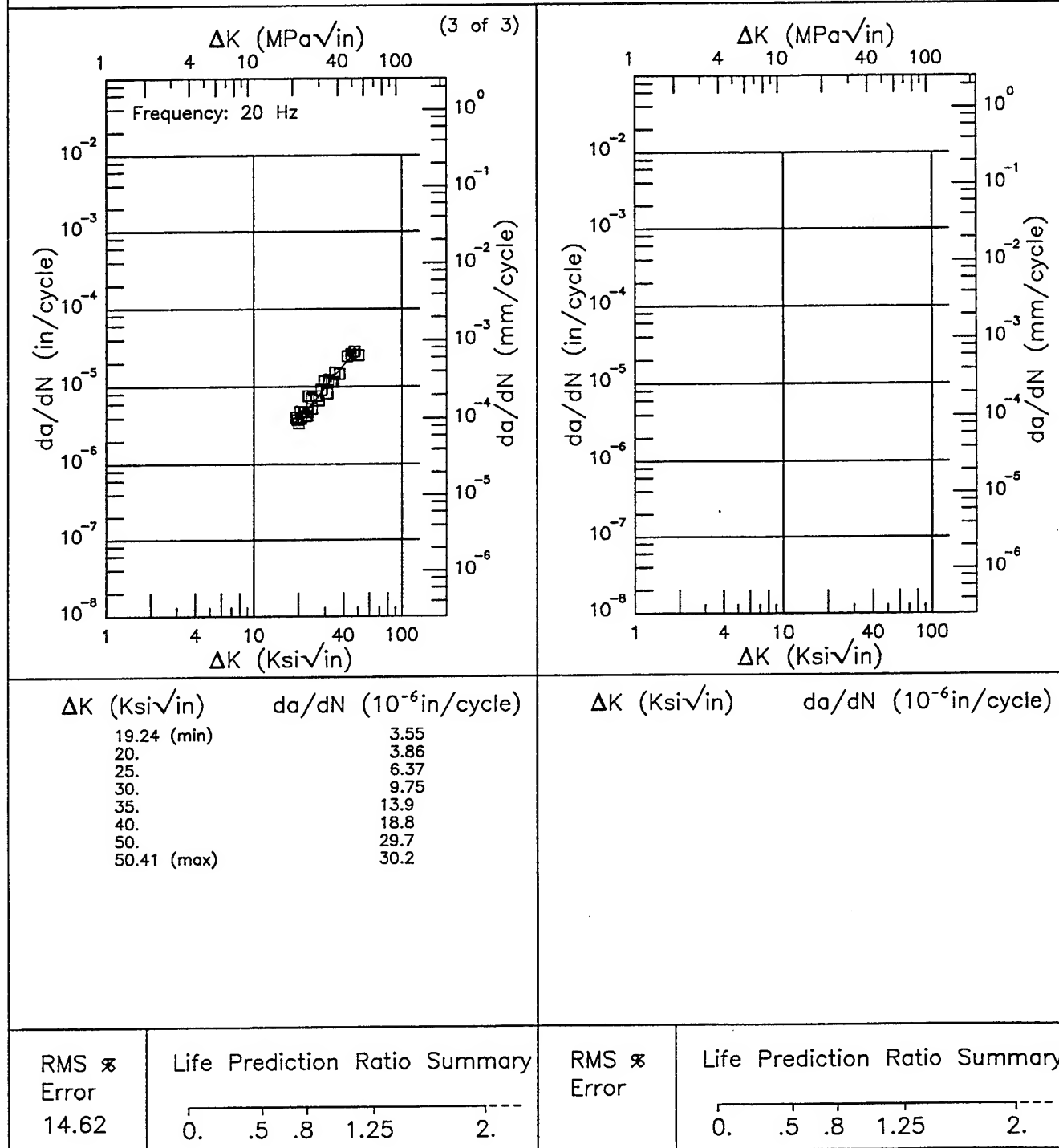
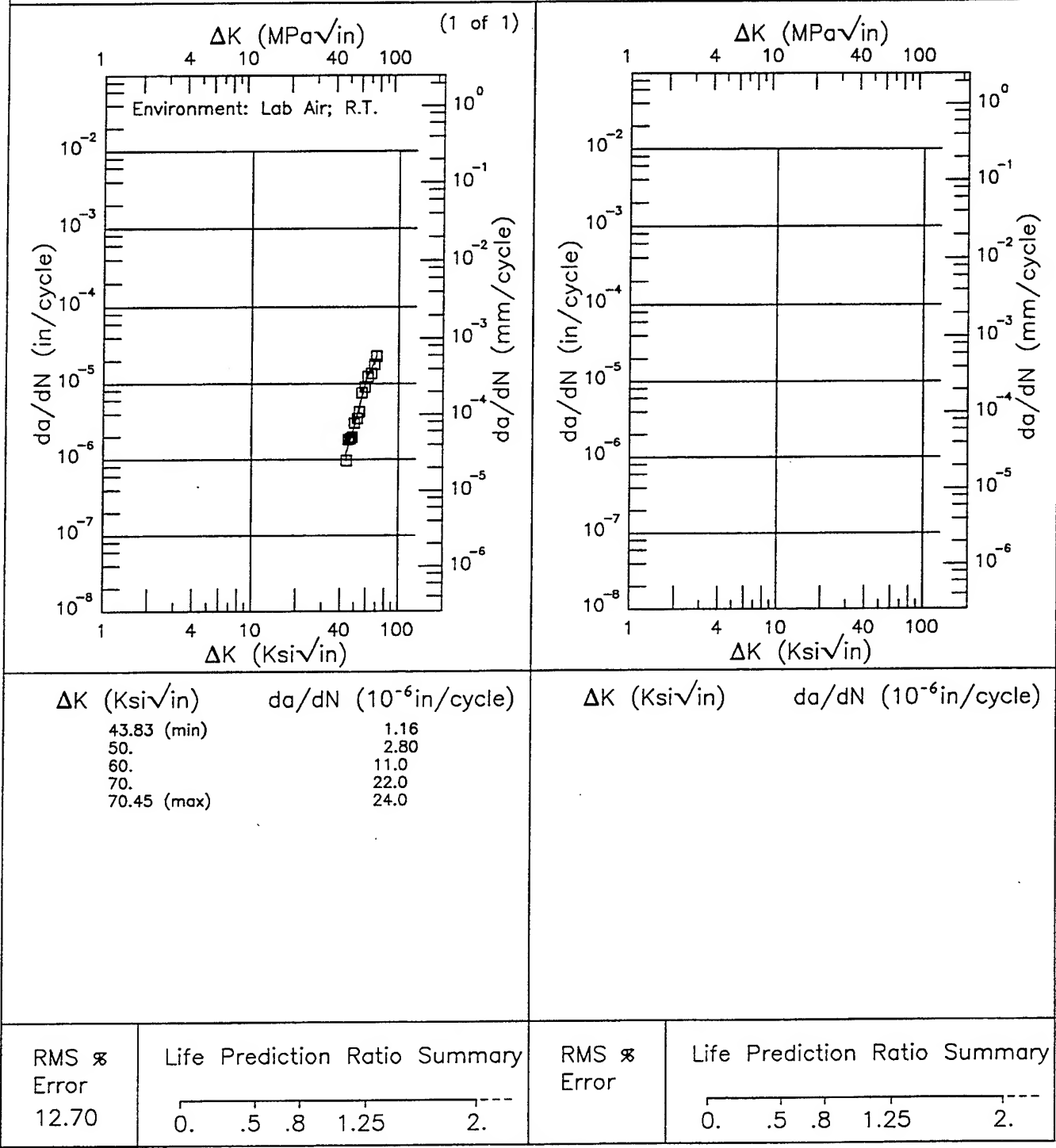


Figure 5.13.3.1.19 (Concluded)

# E | WASPALOY |

Condition/Ht: 2010F 2HRS 1350F 6HRS  
 Form: 1.18 in. Billet  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.1  
 Frequency: 10 Hz

Yield Strength: 95 ksi  
 Ult. Strength: 230.5 ksi  
 Specimen Thk: 0.125 in.  
 Specimen Width: 1.25 in.  
 Ref: UC001



**Figure 5.13.3.1.20**  
 5-196

Condition/Ht: 2010F 2HRS 1600F 24HRS  
 Form: 1.18 in. Billet  
 Specimen Type: CT  
 Orientation:  
 Stress Ratio: 0.1  
 Frequency: 10 Hz

Yield Strength: 96.5 ksi  
 Ult. Strength: 227.5 ksi  
 Specimen Thk: 0.125 in.  
 Specimen Width: 1.25 in.  
 Ref: UC001

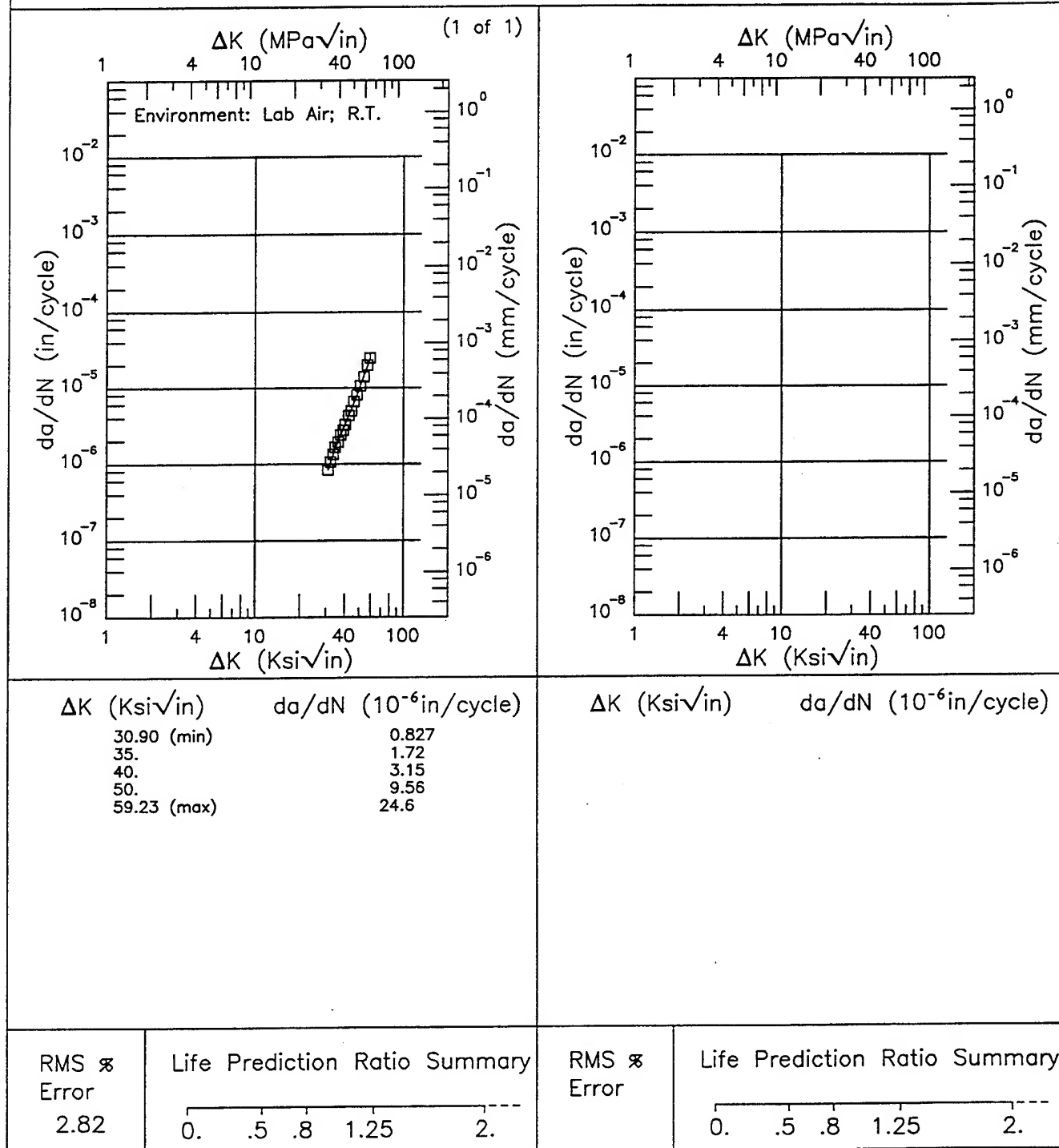


Figure 5.13.3.1.21

TABLE 5.14

REFERENCES FOR THE NICKEL BASE ALLOY DATA

60578	INCONEL 718	$K_I$	Christian, J. L., Yang, C. T., and Witzell, W. E., "Physical and Mechanical Properties of Pressure Vessel Materials for Application in a Cryogenic Environment," ASD-TDR-62-258, Part III, General Dynamics/Astronautics (December 1964).
88187	INCONEL 718	$K_{Ic}$	"Inconel 718 Test Data of September 19, 1973," Schultz Steel Company, South Gate, CA., September 1, 1973.
88579	INCONEL 718	a-vs-N; da/dN	"B-1 Program da/dN Data for Aluminum Alloys," Rockwell International Corporation: Memorandum to H. D. Moran from E. W. Cawthorne, Battelle's Columbus Laboratories, April 3, 1974.
88700	INCONEL 718	$K_{Isc}$	Gilbreath, W. P., and Adamson, M. J., "The Stress Corrosion Susceptibility of Several Alloys in Hydrazine Fuels," NASA Technical Note, Report NASA TN D-7604, Ames Research Center, Moffett Field, CA, February 1974.
GE001	INCONEL 718 P/M RENE 95 RENE 95 (H&F)	da/dN da/dN da/dN	Shanini, V. and Popp, H. G., "Evaluation of Cyclic Behavior of Aircraft Turbine Disk Alloys," General Electric, Evendale, Ohio, Contract No. NAS3-20368, Report No. NASA-CR-159433, June 1978.
GE004	P/M RENE 95	a-vs-N; da/dN	"Argon Environment Testing," Thermal-Mechanical Crack Propagation Program; Data Sheets sent from M. S. Gilbert, General Electric Co., Evendale, Ohio, Contract No. F33615-77-C-5193, November 1980.
GE005	INCONEL 718	da/dN	"Fatigue Crack Growth Rate Data on Inconel 718 Using $K_I$ Bar Specimens from the TF34 DTA Effort;" Data sent from M. S. Gilbert, General Electric Co., Evendale, Ohio, October 1982.



**TABLE 5.14 (CONTINUED)**

**REFERENCES FOR THE NICKEL BASE ALLOY DATA**

GE008	INCONEL 718	da/dN
	P/M RENE 95	da/dN
	Domas, P. A., "Crack Propagation Under Thermal Mechanical Cycling," General Electric Co., Aircraft Engine Group, Evendale, Ohio, Contract No. F33615-77-C-5193, November 1979.	
HD003	INCONEL 600	a-vs-N; da/dN
	James, L. A., "Fatigue Crack Propagation Behavior of Inconel 600," International Journal of Pressure Vessels and Piping, Vol. 5, 241-259. 1977.	
HD005	INCONEL 625	a-vs-N; da/dN
	James, L. A., "The Effect of Temperature upon the Fatigue Crack Propagation Behavior of Inconel 625," Report HEDL-TME 77-2, Westinghouse Hanford Co., Richland, WA., March 1977.	
HD015	INCONEL 718	a-vs-N; da/dN
	James, L. A., "Fatigue Crack Propagation Behavior of Inconel 718," Report HEDL-TME 75-80, Westinghouse Hanford Co., Richland, WA., September 1975.	
HD016	INCONEL 718	a-vs-N; da/dN
	Mills, W. J., and James, L. A., "Effect of Heat Treatment on Elevated Temperatures Fatigue-Crack Growth Behavior of Two Heats of Alloy 718," ASME Paper 78-WA/FVP-2, December 1978.	
HD017	INCONEL 718	a-vs-N; da/dN
	James, L. A., "The Effect of Product Form Upon the Fatigue-Crack Growth Behavior in Alloy 718," Journal of Engineering Materials and Technology, Vol. 103, 234-239, 1981.	
PW001	WASPALLOY	a-vs-N; da/dN
	Larsen, J. M., Schwartz, B. J., Annis, C. G. Jr., "Cumulative Damage Fracture Mechanics Under Engine Spectra," Pratt and Whitney Aircraft Group, Government Product Division, West Palm Beach, Fla., Report No. AFML-TR-77-4159, January 1980.	

**TABLE 5.14 (CONCLUDED)**

**REFERENCES FOR THE NICKEL BASE ALLOY DATA**

PW002	IN100	a-vs-N; da/dN	
	Beyer, J. R., Sims, D. L., and Wallace, R. M., "Titanium Damage Tolerant Design Data for Propulsion Systems," United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, FL, Report AFML-TR-77-101, Contract No. F33615-75-C-5130, June 1977.		
PW003	ASTROLOY 901	da/dN	
	IN100	da/dN	
	INCOLOY 901	da/dN	
	Fatigue Crack Growth Rate Data on Titanium and Nickel Base Alloys from B. S. Schwartz, Pratt and Whitney Aircraft Group, Government Product Division, West Palm Beach, FL., July 1982.		
PW004	ASTROLOY P/M-H	da/dN	
	ASTROLOY P/M-W	da/dN	
	IN100 P/M-G	da/dN	
	NASA IIB-7 P/M	da/dN	
	WASPALLOY	da/dN	
	Cowles, B. A., Sims, D. L., Warren, J. R., "Evaluation of the Cyclic Behavior of Aircraft Turbine Disk Alloys," Pratt and Whitney Aircraft Group, United Technologies Corp., West Palm Beach, FL., Contract No. NAS3-20367, Report No. NASA CR-159409, October 1978.		
PW006	IN100	a-vs-N; da/dN	
	WASPALLOY	da/dN	
	Fatigue Crack Growth Rate Data on Nickel Base Alloys from Pratt and Whitney Aircraft Group, Government Product Division, West Palm Beach, FL., July 1982.		
RI006	INCONEL 718	$K_{Isc}$	
	Ferguson, R. R., Berryman, R. C., "Fracture Mechanics Evaluation of B-1 Materials," Rockwell International B-1 Division, Los Angeles, CA., Contract No. F33657-70-C-0800, Report No. AFML-TR-76-137, October 1976.		
UC001	WASPALLOY	da/dN	
	Lawless, B., et al., "The Effect of Microstructure on the FCP and Overload Behavior of Waspaloy at Room Temperature," Dept. of Materials Science and Metallurgical Engineering, University of Cincinnati, December 1980.		

## CHAPTER 6

### TITANIUM ALLOYS SECTIONS

6.0	Titanium Alloys Material Summaries .....	6-3
6.0.1	Available Data .....	6-3
6.0.2	$K_{Ic}$ Summary .....	6-15
6.0.3.1	$K_c$ Summary (Buckling not Constrained) .....	6-18
6.0.3.2	$K_c$ Summary (Buckling Constrained) .....	6-19
6.0.4	FCGR at Defined $\Delta K$ Levels .....	6-20
6.0.5	$K_{Isc}$ Summary .....	6-35
6.1	BETA .....	6-38
6.2	BETA C .....	6-39
6.3	BETA III .....	6-47
6.4	BETA Ti .....	6-59
6.5	CORONA 5 .....	6-61
6.6	IMI-834 .....	6-62
6.7	Ti-* .....	6-68
6.8	Ti-10-2-3 .....	6-69
6.9	Ti-4Al-3Mo-1V .....	6-72
6.10	Ti-5-2.5 ELI .....	6-73
6.11	Ti-5Al-2.5Sn .....	6-102
6.12	Ti-6-2-2-2-2 .....	6-126
6.13	Ti-6-2-4-2 .....	6-134
6.14	Ti-6-2-4-2 ELI .....	6-141
6.15	Ti-6-2-4-6 .....	6-154
6.16	Ti-6Al-4V .....	6-169
6.17	Ti-6Al-4V ELI .....	6-433
6.18	Ti-6Al-6V-2Sn .....	6-473
6.19	Ti-6Al-6V-2.5Sn .....	6-515
6.20	Ti-6Al2Sn4Zr6Mo .....	6-516
6.21	Ti-8Al-1Mo-1V .....	6-518
6.22	Ti-Mo8V2Fe3Al .....	6-567
6.23	Ti-5Al2.5Sn ELI .....	6-569
6.24	Ti-6Al6V2Sn ELI .....	6-571
6.25	Titanium Alloys References .....	6-573

TABLE 6.0.1

## AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>Ic</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Isc</sub>
BETA	1745F WQ	Sheet						6
	1745F WQ +1095F 1000HR	Sheet						1
	1745F WQ +1095F 16HR	Sheet						2
	1745F WQ +1095F 250HR	Sheet						1
	1745F WQ +1095F 500HR	Sheet						1
	BETA STAB	Sheet						1
BETA-C	STA	Sheet				11		
		Plate		8				
BETA-III	1325F .25HR WQ 925F 8HR	Plate		3				
	1350F 0.5HR WQ 950F 8HR AC	Extrusion		3				
	AGED 1000F 100HR	Unspecified					1	
	AGED 1250F 50HR	Unspecified					1	
	AGED 900F 100HR	Unspecified					1	
	BETA STAB +AGED 900F 11HR	Sheet						7
	STA	Plate				4		
		Plate		1				
	STA - 1325F WQ 1045F 8HR	Plate		1				
	STA - 1325F WQ 1045F 8HR (ELECTRON BEAM WELD ZONE)	Plate		1				
	STA - 1325F WQ 1045F 8HR (HEAT AFFECTED ZONE)	Plate		1				
	STA 900F 100HR	Unspecified					1	
	STA 900F 40HR	Unspecified					1	

TABLE 6.0.1 (CONTINUED)

## AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>Ic</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Iacc</sub>
BETA-III (Cont'd)	STA 900F 8HR	Unspecified					1	
	STA E.B. WELDMENT (HAZ)	Weldment				2		
	STA E.B. WELDMENT (WELD ZONE)	Weldment				1		
BETA-Ti	BETA STABILIZED	Sheet					1	
CORONA 5	ALPHA-BETA FORGED & LOW ANNEAL & AGE	Forging	1					
IMI-834	1864F 2HRS; OQ TO R.T.; AGE 1161F 2HRS	Disk				11		
Ti.*	1740F 1HR AC	Plate	3					
	STA - 1740F 1HR AC 1000F 8HR AC	Plate	3					
	Unspecified	Unspecified				4		
Ti-10-2-3								
Ti-4Al-3Mo-1V	MA	Plate						1
Ti-5-2.5 ELI	Unspecified	Disk				73		
Ti-5Al-2.5Sn	ANNEALED	Sheet		75		64		
Ti-6-2-2-2-2	ST	Plate				4		
	STA	Plate				4		
	1790F 1HR AC 1100F 8HR AC	Forging				9		
Ti-6-2-4-2	ANNEAL 1450F 1HR AC	Plate				13		
Ti-6-2-4-2 ELI	Unspecified	Extrusion				5		
	1690F 2HRS AC 1550F 2HRS OQ 1100F 8HRS AC	Forging				14		
		Unspecified				13		1
Ti-6Al-4V	Unspecified	Forging						11
	1000F 2HR	Forging					2	
	1300F 1HR AC	Forging		4				

TABLE 6.0.1 (CONTINUED)

## AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>IC</sub>	K <sub>C</sub>	R Curve	da/dN	da/dt	K <sub>Isc</sub>
Ti-6Al-4V (Cont'd)	1300F 2HR AC	Extrusion						2
	1450F 1HR AC	Plate	1					
	1550F 4HRS FC 1000F 4HRS ARGON COOLED	Forging				9		
	1700F 4HR FC TO 1400F AC DB THERMAL CYCLE	Plate						9
	1700F 6HR AC 1400F 6HR AC	Forging	12					
	1725F 1HR WQ 1000F 1HR AC (STA)	Extrusion						2
	1725F 1HR WQ 1250F 4HR AC (STOA)	Extrusion						2
	1750F 1.5HR WQ 1050F-1100F 8HR 950F 8HR	Forging						6
	1750F 1000F 2HR AC	Forging						2
	1750F 1HR FC TO 1100F	Plate	3					
	1750F 1HR FC TO RT	Plate	4					
	1750F 1HR WQ 1000F 4HR	Forging	15					
	1750F 2HR FC TO 900F AT 100F/HR AC	Forging	2					
	1750F 2HR WQ 1000F 2HR AC 1300F 2HR AC STA	Plate	2					
	1750F 4HRS ARGON COOLED	Forging				9		
	1750F WQ 1000F 8HR 1000F (ALPHA-BETA)	Forging						4
	1775F 1HR WQ 1675F 1HR WQ 1000F 4HR AC	Disk				2		
	1775F 1HR WQ 1675F 1HR WQ 1000F-1200F 2-9HR AC	Disk				17		
	1790F 1.5HR WQ 1160F 8HR + 1025F 8HR AC	Sheet						2
	1900F 0.5HR AC 1350F 2HRS AC	Plate	1					
	1950F 4HRS WQ 1000F 4HRS ARGON COOLED	Forging				7		

TABLE 6.0.1 (CONTINUED)

## AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>1c</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Isec</sub>
Ti-6Al-4V (Cont'd)	AB FORGED-MA ALPHA-BETA FORGED MA	Forging	12					
	AB FORGED-RA ALPHA-BETA FORGED RA 1700F 4HR FC	Forging	8					
	ALPHA-BETA FORGE-ANNEALED	Forging				3		
	ALPHA-BETA FORGED	Forging						3
	ANNEALED	Sheet		19				
		Forging	17			19		
		Extrusion	19			22		
		Billet	2			2		
	ANNEALED 1000F 2HR AC	Billet	2					
	ANNEALED 1300F 4HR AC	Forging	22					
	ANNEALED 1375F 3HR AC	Plate	2					
	ANNEALED 2200F 2HR	Forging	5					
	ANNEALED AT 1375F 3HRS AC	Plate				2		
	AS RECEIVED	Forged Bar	35					
	AS RECEIVED PROBABLY MA	Plate						1
	AS RECEIVED-AB (ALPHA-BETA FORGED)	Forged Bar	2					
	AS WELDED E.B. WELDMENT (HAZ)	Weldment				1		
	AS WELDED E.B. WELDMENT (WELD ZONE)	Weldment				1		
	B FORGED BETA FORGED REHEATED TO 1950F DRAWN TO SIZE	Forged Bar	4					
	B FORGED-MA BETA FORGED MA	Forging	2					
	B FORGED-MA BETA FORGED MA 1300F 2HR AC	Forging	8					

TABLE 6.0.1 (CONTINUED)

## AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>IC</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Isec</sub>
Ti-6Al-4V (Cont'd)	BA	Sheet				6		
		Plate				21		
		Forging				20		
	BB AB FIN-30MA BETA BLOCKED	Forging	2					
	BB AB FIN-MA BETA BLOCKED	Forging	4					
	BB AB FIN-PA BETA BLOCKED	Forging	4					
	BB AB FIN10STO BETA-BLOCKED	Forging	3					
	BB AB FIN30STO BETA-BLOCKED	Forging	3					
	BB B FIN-10MA BETA BLOCKED	Forging	3					
	BB B FIN10STOA BETA BLOCKED	Forging	3					
	BETA ANNEALED	Plate	6					
	BETA ANNEALED PLATE EB WELDED THEN BETA ANN	Plate	2					
	BETA FORGED	Forging						3
	BETA PROCESSED - MA	Sheet				1		
		Plate	3			6		
		Plate	7			4		
	DB	Billet	7					
	DB + 2DBTC	Plate				2		
	DB + 4DBTC	Plate				1		
	DB + TR	Plate				1		
	DBA	Billet	22					



TABLE 6.0.1 (CONTINUED)

## AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>Ic</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Isc</sub>
Ti-6Al-4V (Cont'd)	DBT + PC	Plate				1		
	DBTC	Plate				12		
	DBTC(RA)	Plate				1		
	EB WELD STRESS RELIEVED (HEAT AFFECTED ZONE)	Weldment					2	
	EB WELD STRESS RELIEVED (WELD ZONE)	Weldment					2	
	FINISH ROLLED 1440F	Plate						11
	GTA WELD POSTWELD 1100F 2HR (HEAT AFFECTED ZONE)	Plate						5
	GTA WELD POSTWELD 1100F 2HR (WELD ZONE)	Plate						1
	GTA WELD POSTWELD 1200F 1HR (HEAT AFFECTED ZONE)	Plate						2
	GTA WELD POSTWELD 1400F 1HR (HEAT AFFECTED ZONE)	Plate						2
	HIP 1650F 15 KSI	Casting				3		
	MA	Unspecified				2		
		Sheet		29		9	16	13
		Plate	13	13		22	2	2
		Forging				10		
		Extrusion	11			25		
	MA 10-20%ALPHA 10 TO 20%PRIMARY ALPHA MA 1300F 2HR AC	Forging	3					
	MA 1300F 2HR AC	Forging	10					
		Billet	3					

TABLE 6.0.1 (CONTINUED)

## AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>Ic</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Iacc</sub>
Ti-6Al-4V (Cont'd)	MA 1300F 2HRS AC	Unspecified				7		
		Disk				5		
	MA 40-50%ALPHA 40 TO 50%PRIMARY ALPHA MA 1300F 2HR AC	Forging	3					
	MA COARSE GRAIN 1300F 2HR AC	Forging	5					
	MA FINE GRAIN 1300F 2HR AC	Forging	6					
	MINUTEMAN CASING	Plate						1
	RA	Plate	46			97		21
		Forging	100			13		8
	RA(FAST COOLED)	Plate				1		
	SOL TREATED 1050F 4+4 HIR	Forging						2
	SOL TREATED 1050F 4HR WELDED 1050F 4HR	Forging						2
	STA	Plate	3					
		Forging	1					
	STOA	Plate				1		
		Forging	1					
	STOA - 1750F 1HR WQ 1300F 2HR AC	Forging	3					
	STRESS RELIEVED E.B. WELDMENT (HAZ)	Weldment				14		
	STRESS RELIEVED E.B. WELDMENT (WELD ZONE)	Weldment				6		
	WELDED & STRESS RELIEVED 1100F 2HRS (HAZ)	Weldment				2		

TABLE 6.0.1 (CONTINUED)

## AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>Ic</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Isec</sub>
Ti-6Al-4V ELI	1800F 1HR HELIUM COOL	Plate						1
	ANNEALED	Sheet		15				
		Forging	6			6		
	BA	Plate				36		
	RA	Plate	6			28		
	1300F 2HR	Forging					2	
Ti-6Al-6V-2Sn	1650F 1HR WQ	Forging	8					
	1675F 2HR AC 1600F 1HR FC	Plate	2					
		Forging	2					
		Forged Bar	2					
		Forging	6					
	ANNEAL - COARSE GRAIN - 1350F 2HR AC	Forging	6					
	ANNEAL - FINE GRAIN - 1350F 2HR AC	Forging						
	ANNEALED 10-20 10-20% PRIMARY ALPHA ANNEALED 1350F 2HR AC	Forging	2					
	ANNEALED 40-60 40-50% PRIMARY ALPHA ANNEALED 1350F 2HR AC	Forging	2					
	BA	Plate				3		
	BB AB FIN-10 BETA BLOCKED ALPHA-BETA FINISHED 10% REDUCTION SOLUTION	Forging	2					
	BB AB FIN-10MA BETA BLOCKED ALPHA-BETA FINISHED 10% REDUCTION MA	Forging	3					
	BB AB FIN-30 BETA BLOCKED ALPHA-BETA FINISHED 30% REDUCTION SOLUTION	Forging	3					
	BB AB FIN-30MA BETA BLOCKED ALPHA-BETA FINISHED 30% REDUCTION MA	Forging	3					

TABLE 6.0.1 (CONTINUED)

## AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>1c</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Isc</sub>
Ti-6Al-6V-2Sn (Cont'd)	BB B FIN-10 BETA BLOCKED BETA FINISHED 10% REDUCTION SOLUTION TREATED & OVERAGED 1650F 1HR WQ 1300F 2HR AC	Forging	2					
	BETA ANNEAL 1810F 1HR ARGON COOL	Plate	3					
	BETA ANNEAL & STOA-1800F 0.6HR AC 1575F 0.6HR WQ 1050F 8HR AC	Plate	2					
	BETA ANNEALED	Plate	1					
	BF AB FOR-ANN BETA FLECTED ALPHA-BETA FORGED ANNEALED 1350F 2HR AC	Forging	3					
	BF B FOR-ANN BETA FLECTED BETA FORGED ANNEALED 1350F 2HR AC	Forging	3					
	BF LAB FOR-ANN BETA FLECTED LOW ALPHA-BETA FORGED (1500F) ANNEALED 1350F 2HR	Forging	3					
	BF LAB FOR-ANN BETA FLECTED LOW ALPHA-BETA FORGED (1500F) ANNEALED 1350F 2HR AC	Forging	3					
	DUPLEX ANNEAL	Plate	3					
	MA	Unspecified				1		
		Plate	6					
		Forging	8			10		
		Extrusion				2		
		Forged Bar	1					
	MA 1000F 2HR AC	Billet	4					
		Billet	2					

TABLE 6.0.1 (CONTINUED)

10 of 12

## AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>Ic</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Iacc</sub>
Ti-6Al-6V-2Sn (Cont'd)	RA	Unspecified				2		
		Plate	1					
	STA - 1600F 0.5HR WQ 1000F 6HR AC	Forging	9					
	STA - 1650F 0.5HR WQ 1050F 24HR AC	Forging	7					
	STA - 1675F 0.25HR WQ 1100F 4HR AC	Plate	3					
	STOA	Plate				14		
	STOA - 1600F 1.5HR WQ 1250F 6HR AC	Extrusion	3					
	STOA - 1650F 1HR WQ 1300F 2HR AC	Forging	2					
	STOA - 1700F 1HR WQ 1400F 1HR AC	Plate	7					
		Billet	8					
		Plate						1
Ti-6Al-6V-2.5Sn	Unspecified							
	1000F 2HR AC	Forging						1
	1300F 2HR AC	Forging						1
	1550F 1HR WQ 900F 4HR AC	Plate						1
	50% PRIMARY ALPHA	Forging	1					
Ti-6Al-2Sn-4Zr-6Mo	BETA PROCESSED	Forging	1					
	BU B FIN-10MA BETA UPSET BETA FINISHED 10% PRIMARY ALPHA MA 1300F 1HR AC	Forging	3					
	BU B FIN-10STA BETA UPSET BETA FINISHED 10% PRIMARY ALPHA SOLUTION TREATED &	Forging	3					
	BU B FIN-10STO BETA UPSET BETA FINISHED 10% PRIMARY ALPHA SOLUTION TREATED & OVERAGED 1625F 1HR AC 1300F 1HR AC	Forging	2					

TABLE 6.0.1 (CONTINUED)

AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>1c</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Isec</sub>
Ti-6Al2Sn4Zr6Mo (Cont'd)	BU B FIN-50MA BETA UPSET BETA FINISHED 50% PRIMARY ALPHA MA 1300F 1HR AC	Forging	2					
	BU B FIN-50STA BETA UPSET BETA FINISHED 50% PRIMARY ALPHA SOLUTION TREATED & AGED 1625F 1HR AC 1100F 8HR AC	Forging	2					
	BU HABFIN10STA BETA UPSET III ALPHA-BETA FINISHED 10% REDUCTION SOLUTION	Forging	3					
	BU HABFIN30STA BETA UPSET III ALPHA-BETA FINISHED 30% REDUCTION SOLUTION TREATED	Forging	3					
	BU LABFIN10STA BETA UPSET LO ALPHA-BETA FINISHED 10% REDUCTION SOLUTION TREA	Forging	3					
	STA - 1625F 2HR AC 1100F 8HR AC	Forging	6					
	Unspecified	Unspecified					6	
Ti-8Al-1Mo-1V	Unspecified	Sheet				2	1	1
	Unspecified	Plate						1
	1520F 1HR WQ	Plate					12	53
	1675F 1HR AC 1075F 8HR AC 1000F 2HR AC	Plate						1
	1700F 1HR AC 1200F 2HR WQ	Plate						1
	1725F FC 1200F 3HR WQ	Plate					8	
	1775F 0.5HR FC TO 1200F 1200F 0.5HR AC 1200F 3HR ARGON QUENCH	Plate						7
	1825F 1HR AC	Plate						1
	1825F 1HR AC 1350F 2HRS AC	Unspecified				4		
	1830F 1HR WQ 1100F 8HRS AC	Forging	1			3		
	2000F 0.5HR AC	Plate						1

TABLE 6.0.1 (CONCLUDED)

## AVAILABLE DATA FOR TITANIUM ALLOYS

Alloy	Condition/ Heat Treatment	Product Form	K <sub>Ic</sub>	K <sub>c</sub>	R Curve	da/dN	da/dt	K <sub>Iacc</sub>
Ti-5Al-1Mo-1V (Cont'd)	DA	Sheet		25		22		
	MA	Sheet				2	1	
		Plate					2	8
	MA 1435F 8HR FC	Sheet						2
Ti-Mo8V2Fe3Al	VAC ANNEALED	Plate						8
	1475F 1.5HR WQ 1000F 8HR AC	Extrusion	3					
	STA REAGED AT 1100F 6HR	Plate	6					
	ANNEALED	Forging	13					
Ti5Al2.5Sn ELI	ANNEALED (ES)	Forging	6					
	ANNEALED (IS)	Forging	5					
	1600F 1HR WQ 1050F 4HR AC	Plate	6					
Ti6Al8V2Sn ELI	1650F 1HR WQ 1125F 4HR AC	Plate	6					

TABLE 6.0.2

1 of 3

**PLANE STRAIN FRACTURE TOUGHNESS VALUES OF TITANIUM ALLOYS  
AT ROOM TEMPERATURE**

Alloy	Condition/ Heat Treatment	Product Form	Range of Product Thickness (in.)	$K_{Ic} (Ksi\sqrt{in})$											
				Specimen Orientation											
				L-T			T-L			S-L					
				Min Spec Thk	n	Mean	Std Dev	Min Spec Thk	n	Mean	Std Dev	Min Spec Thk	n	Mean	Std Dev
BETA-C	STA	Plate	2.50	1.00	3	44.1	1.4	1.00	2	43.9	0.6	---	---	---	---
BETA-III	1325F .25HR WQ 925F 8HR	Plate	0.80	0.75	3	49.8	1.2	---	---	---	---	---	---	---	---
Ti*	1740F 1HR AC	Plate	0.62-1.00	0.63	3	61.6	1.6	---	---	---	---	---	---	---	---
	STA - 1740F 1HR AC 1000F 8HR AC	Plate	0.62	0.62	3	55.3	1.5	---	---	---	---	---	---	---	---
	1700F 6HR AC 1400F 6HR AC	Forging	1.40	1.25	6	75.9	4.2	1.28	6	81.2	5.8	---	---	---	---
	1750F 1HR FC TO 1100F	Plate	1.50	---	---	---	---	1.50	2	91.5	2.1	---	---	---	---
Ti-6Al-4V	1750F 1HR FC TO RT	Plate	1.50	1.50	2	71.8	3.2	1.50	2	91.6	1.3	---	---	---	---
	1750F 1HR WQ 1000F 4HR	Forging	3.00	---	---	---	---	2.00	3	79.3	4.9	---	---	---	---
	1750F 2HR WQ 1000F 2HR AC 1300F 2HR AC STA	Plate	0.62	0.63	2	41.4	2.3	---	---	---	---	---	---	---	---
	AB FORGED-MA ALPHA-BETA FORGED MA	Forging	2.25	---	---	---	---	1.00	4	35.4	2.7	---	---	---	---
	ANNEALED	Forging	1.50-3.00	1.50	4	70.8	15.9	1.49	6	67.3	13.6	---	---	---	---
		Extrusion	1.50-4.00	1.50	5	82.6	5.3	1.49	6	85.2	6.5	---	---	---	---
		Billet	6.00	1.25	2	79.6	9.6	---	---	---	---	---	---	---	---
	ANNEALED 1000F 2HR AC	Billet	2.30	1.25	2	50.9	0.6	---	---	---	---	---	---	---	---
	ANNEALED 1300F 4HR AC	Forging	2.30	0.75	3	58.1	1.2	0.75	3	62.2	3.0	0.75	2	68.1	1.0



TABLE 6.0.2 (CONTINUED)

2 of 3

**PLANE STRAIN FRACTURE TOUGHNESS VALUES OF TITANIUM ALLOYS  
AT ROOM TEMPERATURE**

Alloy	Condition/ Heat Treatment	Product Form	Range of Product Thickness (in.)	$K_{Ic} (Ksi\sqrt{in})$											
				Specimen Orientation											
				L-T			T-L			S-L					
				Min Spec Thk	n	Mean	Std Dev	Min Spec Thk	n	Mean	Std Dev	Min Spec Thk	n	Mean	Std Dev
Ti-6Al-4V (Cont'd)	ANNEALED 1375F 3HR AC	Plate	2.75	1.25	2	60.4	5.5	---	---	---	---	---	---	---	---
	AS RECEIVED	Forged Bar	¾-1.00-3.50	0.56	14	57.1	10.4	0.50	21	54.9	10.8	---	---	---	---
	B FORGED BETA FORGED REHEATED TO 1950F DRAWN TO SIZE	Forged Bar	2.25-3.50	---	---	---	---	1.00	4	42.6	4.3	---	---	---	---
	B FORGED-MA BETA FORGED MA 1300F 2HR AC	Forging	2.00	1.00	3	70.6	4.9	1.00	3	71.0	0.4	1.00	2	73.9	2.5
	BETA PROCESSED - MA	Plate	1.00-3.00	1.50	3	94.9	4.8	---	---	---	---	---	---	---	---
	DBA	Billet	0.62-3.50	0.98	9	68.2	9.7	0.68	13	64.2	11.8	---	---	---	---
	MA	Plate	1.00-2.00	1.24	3	74.4	32.6	1.00	7	91.6	24.4	---	---	---	---
		Extrusion	1.80-4.00	1.47	5	83.5	3.1	1.50	6	87.5	4.1	---	---	---	---
	MA 1300F 2HR AC	Forging	2.00-4.50	1.00	4	50.9	6.9	1.00	3	49.5	3.9	1.00	3	43.6	5.8
		Billet	2.30	1.25	3	84.0	3.4	---	---	---	---	---	---	---	---
	RA	Plate	1.00-2.50	---	22	82.8	7.8	---	22	80.8	10.8	---	---	---	---
		Forging	1.20-6.70	1.25	41	83.6	5.5	1.25	50	83.9	6.9	1.43	9	88.9	3.2
Ti-6Al-4V ELI	STA	Plate	0.62	---	---	---	---	0.63	3	42.6	2.0	---	---	---	---
	ANNEALED	Forging	3.00	2.00	3	89.5	1.3	2.01	3	84.3	0.4	---	---	---	---
	RA	Plate	3.00	2.00	3	76.1	4.0	2.00	3	76.8	0.7	---	---	---	---

TABLE 6.0.2 (CONCLUDED)

3 of 3

**PLANE STRAIN FRACTURE TOUGHNESS VALUES OF TITANIUM ALLOYS  
AT ROOM TEMPERATURE**

Alloy	Condition/ Heat Treatment	Product Form	Range of Product Thickness (in.)	$K_{Ic} (Ksi\sqrt{in})$											
				Specimen Orientation											
				L-T			T-L			S-L					
				Min Spec Thk	n	Mean	Std Dev	Min Spec Thk	n	Mean	Std Dev	Min Spec Thk	n	Mean	Std Dev
Ti-6Al-6V-2Sn	BETA ANNEAL 1810F 1HR ARGON COOL	Plate	0.50	---	---	---	---	0.45	3	54.3	2.0	---	---	---	---
	BETA ANNEAL & STOA-1800F 0.5HR AC 1875F 0.5HR WQ 1050F 8HR AC	Plate	0.62	0.63	2	50.1	1.8	---	---	---	---	---	---	---	---
	DUPLEX ANNEAL	Plate	0.50-1.00	---	---	---	---	0.50	3	65.1	2.0	---	---	---	---
	MA	Plate	0.50-1.00	---	---	---	---	0.49	4	35.0	5.2	---	---	---	---
		Forging	3.80	1.00	3	58.6	2.7	---	---	---	---	---	---	---	---
		Billet	2.20	1.24	4	52.3	6.4	---	---	---	---	---	---	---	---
	MA 1000F 2HR AC	Billet	2.20	1.25	2	57.1	2.2	---	---	---	---	---	---	---	---
	STA - 1600F 0.5HR WQ 1000F 6HR AC	Forging	3.80	1.01	3	30.8	0.7	---	---	---	---	---	---	---	---
	STA - 1875F 0.25HR WQ 1100F 4HR AC	Plate	1.25	---	---	---	---	0.60	3	34.1	3.8	---	---	---	---
	STOA - 1700F 1HR WQ 1400F 1HR AC	Plate	0.38	0.38	3	42.9	1.3	0.38	4	46.1	3.1	---	---	---	---
Ti-Mo3V2Fe3Al		Billet	%12.00	1.02	4	62.8	6.9	1.02	4	57.0	3.7	---	---	---	---
	STA REAGED AT 1100F 6HR	Plate	1.00	1.00	3	54.0	1.0	0.99	3	53.9	1.0	---	---	---	---
Ti6Al6V2Sn ELI	1600F 1HR WQ 1050F 4HR AC	Plate	1.00	0.25	3	29.8	0.5	---	---	---	---	---	---	---	---
	1650F 1HR WQ 1125F 4HR AC	Plate	1.00	0.25	2	34.0	3.5	---	---	---	---	---	---	---	---

TABLE 6.0.3.1

**PLANE STRESS AND TRANSITIONAL FRACTURE TOUGHNESS  
OF TITANIUM ALLOYS (WITHOUT BUCKLING CONSTRAINTS)**

Alloy	Condition/ Heat Treatment	Test Temp (°F)	Specimen		Yield Strength (Ksi)	$K_{\epsilon} (K_{st}/\sqrt{in})$											
						Specimen Thickness (in.)						n - Sample size $\mu$ - Mean $\sigma$ - Standard Deviation					
						0.02			0.04			0.05					
						n	$\mu$	$\sigma$	n	$\mu$	$\sigma$	n	$\mu$	$\sigma$	n	$\mu$	$\sigma$
Ti-5Al-2.5Sn	ANNEALED	-423.	Orient	Width (in.)	203.5	6	115.6	4.9	---	---	---	---	---	---	---	---	---
				3.0		9	109.4	6.6	---	---	---	---	---	---	---	---	---
				6.0		14	107.0	9.0	---	---	---	---	---	---	---	---	---
				12.0		2	97.1	9.6	---	---	---	---	---	---	---	---	---
			Width (in.)	16.0	193.3	2	107.7	16.0	2	147.6	28.9	---	---	---	---	---	---
Ti-6Al-4V	MA	-320.	T-L	12.0	207.3-211.8	2	107.7	16.0	2	147.6	28.9	---	---	---	---	---	---
		-110.	L-T	16.0	171.2	2	141.8	2.7	---	---	---	---	---	---	---	---	---
			T-L	8.0	163.3-164.3	---	---	---	---	---	---	2	159.4	7.5	---	---	---
			L-T	24.0	133.8-136.7	---	---	---	---	---	---	6	196.4	19.9	---	---	---
Ti-6Al-4V ELI	ANNEALED	R.T.	L-T	18.0	136.0	5	161.6	6.5	---	---	---	---	---	---	---	---	---
		R.T.	L-T	12.0	135.5	3	111.7	15.0	---	---	---	---	---	---	---	---	---
Ti-8Al-1Mo-1V	DA	R.T.	L-T	20.0	133.6	---	---	---	---	---	---	4	220.5	15.8	---	---	---

TABLE 6.0.3.2

1 of 1

**PLANE STRESS AND TRANSITIONAL FRACTURE TOUGHNESS  
OF TITANIUM ALLOY (WITH BUCKLING CONSTRAINTS)**

Alloy	Condition/ Heat Treatment	Test Temp (°F)	Specimen		Yield Strength (Ksi)	$K_c$ ( $Ksi\sqrt{in}$ )											
						Specimen Thickness (in.)					n - Sample size $\mu$ - Mean $\sigma$ - Standard Deviation						
			Orient	Width (in.)		0.400											
						n	$\mu$	$\sigma$	n	$\mu$	$\sigma$	n	$\mu$	$\sigma$	n	$\mu$	$\sigma$
Ti-6Al-4V	1300F 1HR AC	R.T.	L-T	6.0	147.1	2	144.3	3.7									

TABLE 6.0.4.1

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: Unspecified		STRESS RATIO: 0.1 - 0.7		FREQUENCY: 0.1 - 30. Hz				
ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)			
					$\Delta K$ Level (Ksi/in)			
					2.5	5.0	10.0	100.0
Ti-6Al-4V	BA	SHEET	0.1	10			4.66	
			0.1	10			1.84	122.21
			0.3	10			14.91	210.93
			0.7	10			3.87	26.35
	HIP 1650F 15 KSI	CASTING	0.1	0.1-20			0.16	5.23
		Unspecified	0.1	30			1.33	

TABLE 6.0.4.2

1 of 5

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: L-T      STRESS RATIO: -1.0 - 0.8      FREQUENCY: 0.1 TO 55. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (KSI/in)					
					2.5	5.0	10.0	20.0	50.0	100.0
Ti-10-2-3	Unspecified	Unspecified	0.05	10		0.48				
			0.1	10			1.16			
			0.33	10		0.65				
Ti-5Al-2.5Sn	ANNEALED	SHEET	0.1	30				11.56	123.8	
			0.1	50				11.69		
			0.67	55		0.15	2.17			
Ti-6-2-4-2 ELI	ANNEAL 1450F 1HR AC	PLATE	-0.3	9				21.3		
			0.1	9				13.49		
			0.5	9				43.6		
Ti-6-2-4-6	Unspecified	EXTRUSION	0.1	20			0.82	9.45		
Ti-6Al-4V	ALPHA-BETA FORGE-ANNEALED	FORGING	0.1	30			1.02			
			0.1	30		0.05				
			0.1	30		0.05				
	ANNEALED	FORGING	-1	5			0.87	10.33		
			0.1	5			0.29	9.53		
			0.1	15				11.12		

TABLE 6.0.4.2 (CONTINUED)

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: L-T      STRESS RATIO: -1.0 - 0.8      FREQUENCY: 0.1 TO 55. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (Ksi/in)					
					2.5	5.0	10.0	20.0	50.0	100.0
Ti-6Al-4V (Cont'd)		FORGING (Cont'd)	0.1	20			0.38			
			0.4	10		0.05	1.32	16.33		
			0.4	20			1.09	17.6		
			0.8	15		0.07				
			-1	5			0.41	7.29		
	ANNEALED (Cont'd)	EXTRUSION	0.1	8			0.34	11.63		
			0.1	15				8.68	242.97	
			0.1	20			0.18			
			0.4	15			0.03	16.54		
			0.8	10			1.68			
			0.8	15			0.1	1.37		
			0.8	30			0.08	1		
	ANNEALED AT 1375F 3HRS AC BA	BILLET	0.02	10-20			0.27	11.05		
		PLATE	0.02	10-20			0.25	11.03		
		FORGING	0.02	0.1-20				2.55	105.12	

TABLE 6.0.4.2 (CONTINUED)

3 of 5

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: L-T      STRESS RATIO: -1.0 - 0.8      FREQUENCY: 0.1 TO 55. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (KSI/in)					
					2.5	5.0	10.0	20.0	50.0	100.0
Ti-6Al-4V (Cont'd)	BETA PROCESSED - MA	PLATE	0.1	1				0.87		
			0.5	1			1.84			
	MA	PLATE	-1	10			1.14	12.91	322.86	
			0.02	0.1-20			0.32	10.8		
			0.02	1-27			0.11			
			0.02	5-30		0.02	0.4	15.79		
			0.02	0.1-30			0.15	6.77		
			0.04	20					93.19	
			0.05	20				6.34		
			0.3	20			0.99			
			0.5	10			8.51	97.18		
		FORGING	0.02	1-30				8.18	292.11	
		EXTRUSION	0.1	10			4.64			
			0.1	1-10				9.35	189.23	
			0.1	1-20				12.2	225.55	
		Unspecified	0.3	10			8.82			
			0.55	10			0.84			



TABLE 6.0.4.2 (CONTINUED)

4 of 5

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: L-T      STRESS RATIO: -1.0 - 0.8      FREQUENCY: 0.1 TO 55. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
					2.5	5.0	10.0	20.0	50.0	100.0
Ti-6Al-4V ELI	ANNEALED	FORGING	0.1	1-10				13.27	209.7	
			-1	8			3.1			
			-1	10				23.32		
			-0.66	8			2.97	22.01		
			-0.66	10				23.96		
	RA	PLATE	-0.33	8			2.5	21.42		
			-0.33	10				20.27		
			0.	8			1.61	21.49		
			0.	10			1.71	18.61		
			0.1	10				11.54		
Ti-6Al-6V-2Sn	MA	EXTRUSION	0.55	8	0.01	0.2	5.22			
			0.02	0.1-10			0.43	8		
			0.02	20		0.05	0.65			

TABLE 6.0.4.2 (CONCLUDED)

5 of 5

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: L-T      STRESS RATIO: -1.0 - 0.8      FREQUENCY: 0.1 TO 55. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (KSI/in)					
					2.5	5.0	10.0	20.0	50.0	100.0
Ti-8Al-1Mo-1V	1825F 1HR AC 1350F 2HRS AC	Unspecified	0.	0.33				10.22		
			0.04	0.33			0.51			
	DA	SHEET	0.1	43				7.92	238.6	
			0.25	1-30					160.57	
			0.67	1-30			2.54			
	MA	SHEET	0.1	43				7.3		
	Unspecified	SHEET	0.02	0.1-12			2.28	13.54	144.35	

TABLE 6.0.4.3

1 of 2

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: T-L			STRESS RATIO: 0.02 - 0.8			FREQUENCY: 0.1 - 58.3 Hz					
ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-8}$ in/cycle)						
					$\Delta K$ Level (Ksn/in)						
					2.5	5.0	10.0	20.0	50.0	100.0	
Ti-5Al-2.5Sn	ANNEALED	SHEET	0.1	30					11.18	140.04	
			0.1	50					11.76		
			0.67	55-58.3		0.16	3.08				
			0.1	5					13.11		
			0.1	20			0.65	12.14			
Ti-6Al-4V	ANNEALED	FORGING	0.4	10		0.1	2.41	18.6			
			0.4	20		0.05	1.41	17.34			
			0.8	15		0.23					
			0.8	30		0.25	6.32				
			0.1	5-10			0.34	7.95			
		EXTRUSION	0.1	15					5.84	161.87	
			0.1	20		0.01	0.2				
			0.4	5-15		0.06	0.84	14.05			
			0.4	15		0.03	0.4	13.39			
			0.8	30		0.08	0.87				

TABLE 6.0.4.3 (CONCLUDED)

2 of 2

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: T-L      STRESS RATIO: 0.02 - 0.8      FREQUENCY: 0.1 - 58.3 Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-8}$ in/cycle)					
					$\Delta K$ Level (Ksi/in)					
					2.5	5.0	10.0	20.0	50.0	100.0
Ti-6Al-4V (Cont'd)	AS WELDED E.B. WELDMENT (HAZ)	WELDMENT	0.1	10				6.52		
	AS WELDED E.B. WELDMENT (WELD ZONE)	WELDMENT	0.1	10				5.94		
	BA	FORGING	0.02	0.1-20				1.93	94.89	
	MA	EXTRUSION	0.1	5-20				13.75	276.81	
	RA	PLATE	0.1	10				23.53		
	STRESS RELIEVED E.B. WELDMENT (HAZ)	WELDMENT	0.1	10				11.35	508.19	
	STRESS RELIEVED E.B. WELDMENT (WELD ZONE)	WELDMENT	0.1	10				10.93		
Ti-6Al-4V ELI	ANNEALED	FORGING	0.1	1-10				12.21	249.29	
			0.1	5-20				8.34	158.75	
	RA	PLATE	0.1	1-10				7.61	227.75	

TABLE 6.0.4.4

1 of 1

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: R-C      STRESS RATIO: 0.05 - 0.5      FREQUENCY: 0.1 - 10. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (Ksi/in)					
					2.5	5.0	10.0	20.0	50.0	100.0
Ti-5-2.5 ELI	Unspecified	DISK	0.05	0.1				11.41		
			0.05	10				11.62	142.07	
			0.5	0.1			2.35	16.79		
			0.5	10			2.76	17.77		

TABLE 6.0.4.5

1 of 2

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: C-R      STRESS RATIO: -1.0 - 0.7      FREQUENCY: 0.1 - 30. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
					2.5	5.0	10.0	20.0	50.0	100.0
IMI-834	1864F 2HRS; OQ TO R.T.; AGE 1161F 2HRS	DISK	0.1	1			0.22	7.72		
Ti-5-2.5 ELI	Unspecified	DISK	0.05	0.1				12.29		
			0.05	10		1.88	19.49	261.66	106.63	
			0.5	0.1			2.79	15.32		
			0.5	10			2.81	24.16		
Ti-6-2-4-2	1790F 1HR AC 1100F 8HR AC	FORGING	0.1	0.16				10		
			0.5	0.16			2.3			
Ti-6-2-4-6	1690F 2HRS AC 1550F 2HRS OQ 1100F 8HRS AC	FORGING	0.1	30		0.1	1.01			
			0.7	0.16	0.06	0.55				
Ti-6Al-4V	1775F 1HR WQ 1675F 1HR WQ 1000F 4HR AC	DISK	0.05	0.33-10					162.45	
			0.03	0.33			0.82	11.45		
	1775F 1HR WQ 1675F 1HR WQ 1000F-1200F 2-8HR AC	DISK	0.03	0.5				9.93		
			0.25	0.33				22.1		
			0.25	0.5				17.73		



TABLE 6.0.4.5 (CONCLUDED)

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: C-R			STRESS RATIO: -1.0 - 0.7		FREQUENCY: 0.1 - 30. Hz						
ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)						
					$\Delta K$ Level (Ksi/in)						
					2.5	5.0	10.0	20.0	50.0	100.0	
Ti-6Al-4V (Cont'd)	Unspecified	Unspecified	-1	0.16			1.14				
			-0.5	0.16			1.21				
			0.1	20				10.35			
			0.3	20			1.66	16.26			
			0.5	20			1.82				
			0.7	20		0.15					
Ti-8Al-1Mo-1V	1830F 1HR WQ 1100F 8HRS AC	FORGING	0.1	30		0.13	1.14				

TABLE 6.0.4.6

1 of 1

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: C-S			STRESS RATIO: 0.05 - 0.5		FREQUENCY: 0.1 - 10. Hz						
ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-8}$ in/cycle)						
					$\Delta K$ Level (Ksi/in)						
					2.5	5.0	10.0	20.0	50.0	100.0	
Ti-5-2.5 ELI	Unspecified	DISK	0.05	10							
			0.5	0.1			0.9	7.78			
			0.5	10			0.46	8.85			



TABLE 6.0.4.7

1 of 1

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: S-C		STRESS RATIO: 0.05 - 0.5		FREQUENCY: 0.1 - 10. Hz						
ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (Ksi/in)					
					2.5	5.0	10.0	20.0	50.0	100.0
Ti-5-2.5 ELI	Unspecified	DISK	0.05	0.1				9.9	200.55	
			0.05	10				10.05	196.41	
			0.5	0.1			1.8	15.77		
			0.5	10			3	18.45		

TABLE 6.0.4.8

1 of 1

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: R-S      STRESS RATIO: 0.05 - 0.5      FREQUENCY: 0.1 - 10. Hz

ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
					$\Delta K$ Level (Ksi/in)					
					2.5	5.0	10.0	20.0	50.0	100.0
Ti-5-2.5 ELI	Unspecified	DISK	0.05	0.1			0.44	3.78		
			0.05	10			0.08	3.48	71.92	
			0.5	10			0.93	13.57		

TABLE 6.0.4.9

1 of 1

**FATIGUE CRACK GROWTH RATE (FCGR) COMPARISON  
AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
FOR TITANIUM ALLOYS IN LAB AIR AT ROOM TEMPERATURE**

ORIENTATION: S-R			STRESS RATIO: 0.05 - 0.5		FREQUENCY: 0.1 - 10. Hz						
ALLOY	CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)						
					$\Delta K$ Level (Ksi/in)						
					2.5	5.0	10.0	20.0	50.0	100.0	
Ti-5-2.5 ELI	Unspecified	DISK	0.05	0.1				8.45			
			0.05	10				7.15	194.49		
			0.5	0.1			1.9	14.85			
			0.5	10			1.89	20.85			

TABLE 6.0.5

STRESS CORROSION CRACKING THRESHOLD DATA FOR TITANIUM ALLOYS AT ROOM TEMPERATURE							
Alloy	Condition/ Heat Treatment	Product Form	Specimen Orientation	$K_{Isc}$ $K_{SI}/\sqrt{in}$			
				Environment			
				3.5% NaCl	Sump Tank Water	Shop Cleaning Solvent	JP-4 Jet Fuel
BETA	BETA STAB	Sheet	L-S	68			
Ti-4Al-3Mo-1V	MA	Plate	L-S	105			
	1300F 2HR AC	Extrusion	L-S	65			
Ti-6Al-4V			L-T	73			
			L-T		66		
	1700F 4HR FC TO 1400F AC DB THERMAL CYCLE	Plate	T-L		55.2(5)	69	
	1725F 1HR WQ 1000F 1HR AC (STA)	Extrusion	L-S	48.5(2)			
	1725F 1HR WQ 1250F 4HR AC (STOA)	Extrusion	L-S	65(2)			
	1750F 1000F 2HR AC	Forging	L-T	31			43.3
	ALPHA-BETA FORGED	Forging	T-L	27			
	AS RECEIVED PROBABLY MA	Plate	T-S	105			
	BETA FORGED	Forging	T-L	34			
	FINISH ROLLED 1440F	Plate	T-S	82.6(11)			
	GTA WELD POSTWELD 1100F 2HR (HEAT AFFECTED ZONE)	Plate	L-T		74.3(3)	64	
	GTA WELD POSTWELD 1100F 2HR (WELD ZONE)	Plate	L-T		93		
	GTA WELD POSTWELD 1200F 1HR (HEAT AFFECTED ZONE)	Plate	L-T		66.5(2)		

TABLE 6.0.5 (CONTINUED)

STRESS CORROSION CRACKING THRESHOLD DATA FOR TITANIUM ALLOYS AT ROOM TEMPERATURE							
Alloy	Condition/ Heat Treatment	Product Form	Specimen Orientation	$K_{Isc}$ $K_{SI}/in$			
				Environment			
				3.5% NaCl	Sump Tank Water	Shop Cleaning Solvent	JP-4 Jet Fuel
	GTA WELD POSTWELD 1400F 1HR (HEAT AFFECTED ZONE)	Plate	L-T		66(2)		
Ti-6Al-4V (Cont'd)	MA	Plate	L-S	32			
			T-S	67			
			T-S	55			
	RA	Plate	L-T		61.7(12)		
			T-L		59.8(6)	69(2)	
		Forging	T-L		53(2)		
			S-L		53.7(6)		
Ti-6Al-4V ELI	1800F 1HR HELIUM COOL	Plate	T-S	84			
Ti-6Al-6V-2.5Sn	1000F 2HR AC	Forging	L-T				30.5
	1300F 2HR AC	Forging	L-T	32.4			
	1550F 1HR WQ 900F 4HR AC	Plate	T-S	21			
	1520F 1HR WQ	Plate	T-L				13.8
Ti-8Al-1Mo-1V	1675F 1HR AC 1075F 8HR AC 1000F 2HR AC	Plate	T-L	26.4			
	1700F 1HR AC 1200F 2HR WQ	Plate	T-S	28			
	1825F 1HR AC	Plate	T-S	23			
	2000F 0.5HR AC	Plate	T-L	47.3			

TABLE 6.0.5 (CONCLUDED)

3 of 3

STRESS CORROSION CRACKING THESHOLD DATA FOR TITANIUM ALLOYS AT ROOM TEMPERATURE								
Alloy	Condition/ Heat Treatment	Product Form	Specimen Orientation	$K_{I_{cc}} \text{ Ksi}/\sqrt{in}$				
				Environment				
				3.5% NaCl	Sump Tank Water	Shop Cleaning Solvent	JP-4 Jet Fuel	Methanol
Ti-8Al-1Mo-1V (Cont'd)	MA	Plate	L-S	20				
			T-S	43.4(7)				
	MA 1435F 8HR FC	Sheet	T-S	21.5(2)				
		VAC ANNEALED	Plate	T-L	24.3(3)			

TABLE 6.1.3.3

(1 of 1)

 $K_{Iacc}$  SUMMARY FOR TITANIUM ALLOY BETA

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	K <sub>Q</sub> (Ksi√in)	K <sub>I<sub>acc</sub></sub> (Ksi√in)	Test Time (min)	Test Date	Reference
						Design	Width (in)	Thick (in)							
1745F WQ	S	R.T.	---	---	.6M KCL -1000MV	SENT	---	---	---	---	100	>55*	---	1970	82651
					.6M KCl -750MV	SENT	---	---	---	100	28*	---	1970	82651	
					.6M KCl -500MV	SENT	---	---	---	100	22*	---	1970	82651	
					.6M KCL 0 MV	SENT	---	---	---	100	32*	---	1970	82651	
					.6M KCL +500MV	SENT	---	---	---	100	34*	---	1970	82651	
					.6M KCL +1000MV	SENT	---	---	---	100	44*	---	1970	82651	
1745F WQ +1095F 16HR	S	R.T.	---	---	.6M KCl -500MV	SENT	---	---	---	60	26*	---	1970	82651	
					.6M KCl -500MV	SENT	---	---	---	32	22*	---	1970	82651	
1745F WQ +1095F 250HR	S	R.T.	---	---	.6M KCl -500MV	SENT	---	---	---	22	16*	---	1970	82651	
1745F WQ +1095F 500HR	S	R.T.	---	---	.6M KCl -500MV	SENT	---	---	---	8	8*	---	1970	82651	
1745F WQ +1095F 1000HR	S	R.T.	---	---	.6M KCl -500MV	SENT	---	---	---	8	8*	---	1970	82651	
BETA STAB	S	R.T.	L-S	136	3.5% NaCl	CNT	8	0.16	0.16	---	72	<68*	---	1969	77456

\* specimen thickness does not meet minimum requirements of  $2.5 \left( \frac{K_{Iacc}}{\sigma_y} \right)^2$

TABLE 6.2.1.1

1 of 1

**MEAN PLANE STRAIN FRACTURE TOUGHNESS  
FOR TITANIUM ALLOY BETA-C AT ROOM TEMPERATURE**

Product Form	Condition/Heat Treatment	$K_{Ic}$ ( $ksi\sqrt{in}$ )									
		Specimen Orientation									
		L-T			T-L			S-L			
		Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	
Plate	STA	44.1	1.4	3	43.9	0.6	2	---	---	---	



TABLE 6.2.1.2.1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**BETA C AT ROOM TEMPERATURE**

**ORIENTATION: L-T**                      **ENVIRONMENT: Dry Air**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)				
				$\Delta K$ Level (Ksi $\sqrt{in}$ )				
				2.5	5.0	10.0	20.0	50.0
								100.0
STA	SHEET	0.1	6			2.26	12.83	

TABLE 6.2.1.2.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
BETA C AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: S.T.W.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
STA	SHEET	0.1	0.1-1			3.35	20.23		

TABLE 6.2.2.1

TITANIUM BETA C $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • $(K_{Ic}TYS)^2$ (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ (Ksi • $\sqrt{\text{in.}}$ )	$K_{Ic}$ MEAN	STAN DEV		
STA	Plate	2.50	-65	L-T	---	1.995	1.001	CT	1.107	0.07	31.40	31.1	0.5	1974	88575 (1)
		2.50				2.002	1.000	CT	1.076	0.06	30.50			1974	88575 (1)
		2.50				1.988	0.998	CT	1.044	0.07	31.30			1974	88575 (1)
STA	Plate	2.50	R.T.	L-T	180.0	1.993	0.999	CT	1.042	0.15	43.80	44.1	1.4	1974	88575
		2.50				1.994	1.004	CT	1.074	0.14	42.80			1974	88575
		2.50				1.996	1.000	CT	1.090	0.16	45.60			1974	88575
STA	Plate	2.50	R.T.	T-L	180.0	1.996	1.002	CT	1.047	0.14	43.40	43.9	0.6	1974	88575
		2.50				1.995	1.001	CT	1.041	0.15	44.30			1974	88575

NOTES: (1) TYS APPROX. 190

**This page intentionally left blank**

R

BETA C

Condition/Ht: STA  
 Form: 0.13 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Frequency: 6 Hz  
 Environment: DRY AIR; RT

Yield Strength: 167.7 ksi  
 Ult. Strength: 183.5 ksi  
 Specimen Thk: 0.125 - 0.126 in.  
 Specimen Width: 6.002 - 6.026 in.  
 Ref: 88575

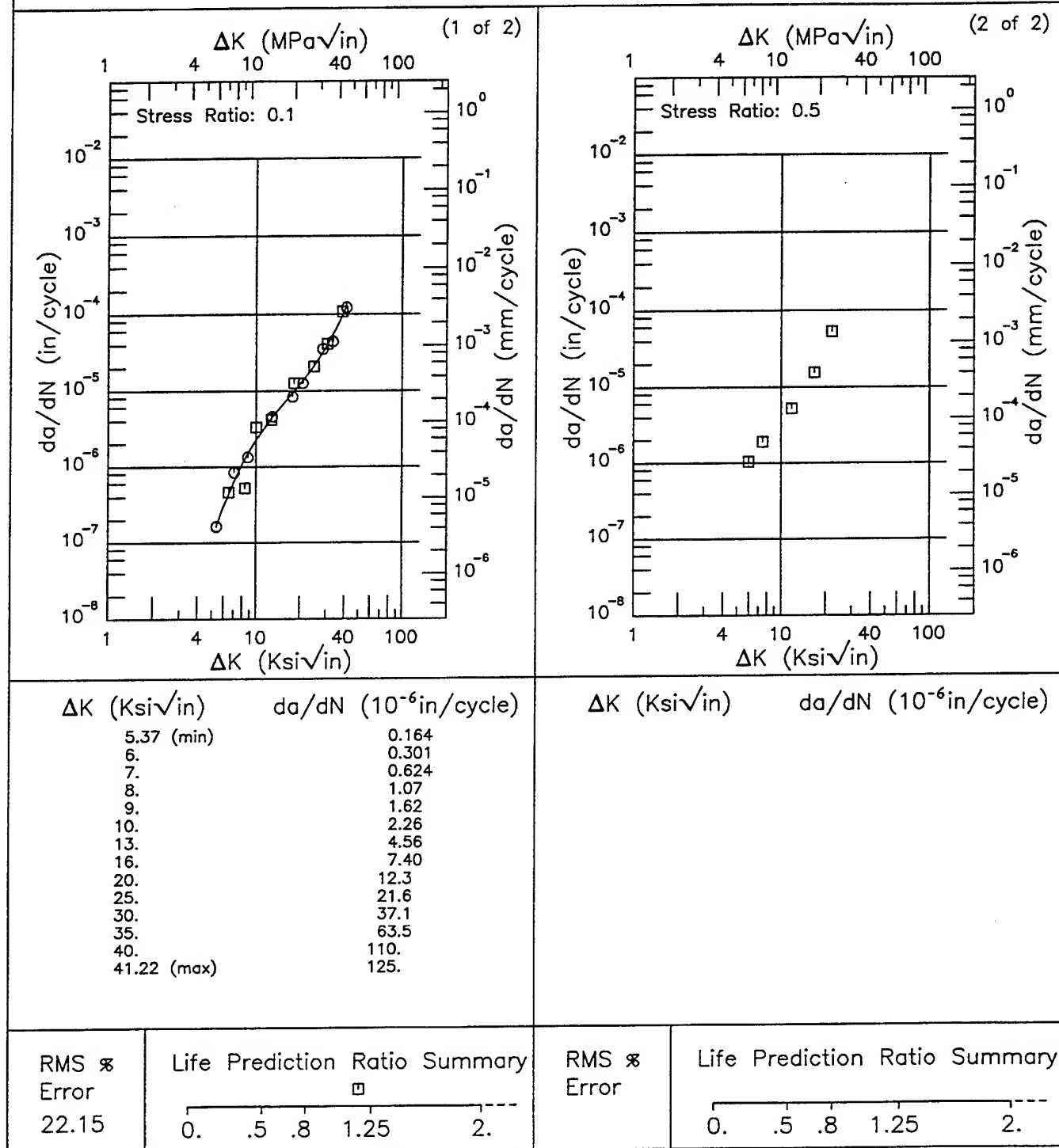


Figure 6.2.3.1.1

Condition/Ht: STA  
Form: 0.12 - 0.13 in. Sheet  
Specimen Type: CCP (max load specified)  
Orientation: L-T  
Frequency: 0.1 - 1 Hz  
Environment: S.T.W.; RT

Yield Strength: 167.7 ksi  
Ult. Strength: 183.5 ksi  
Specimen Thk: 0.116 - 0.127 in.  
Specimen Width: 6.002 - 6.023 in.  
Ref: 88575

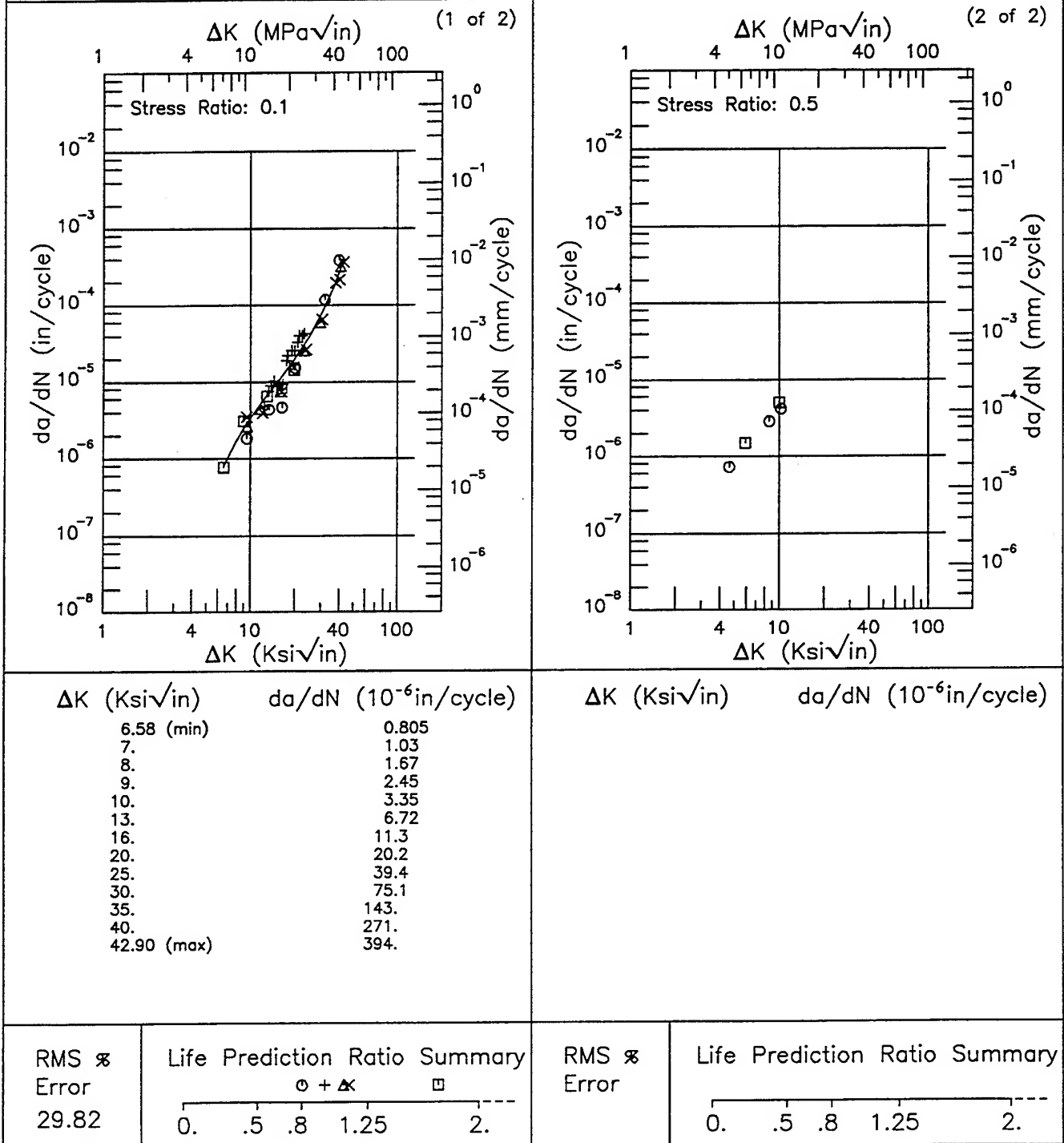
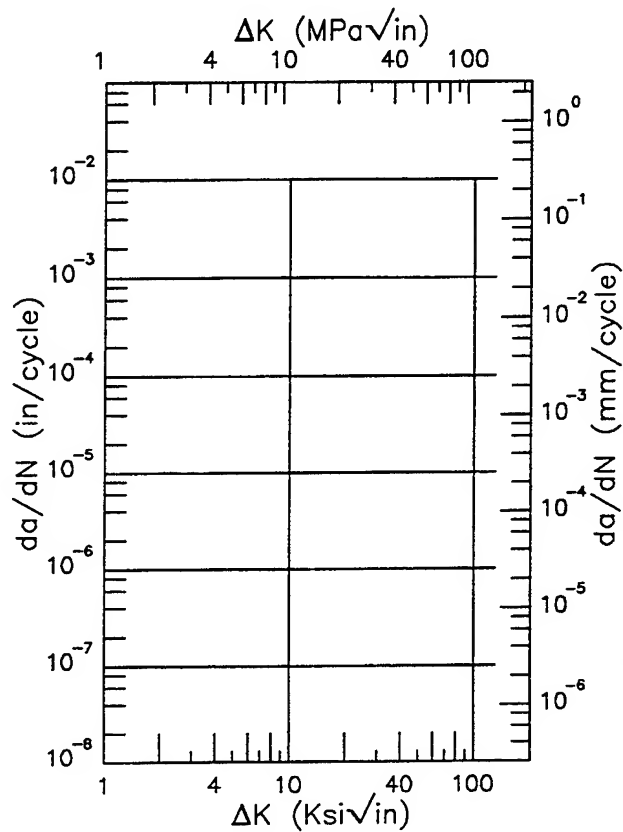
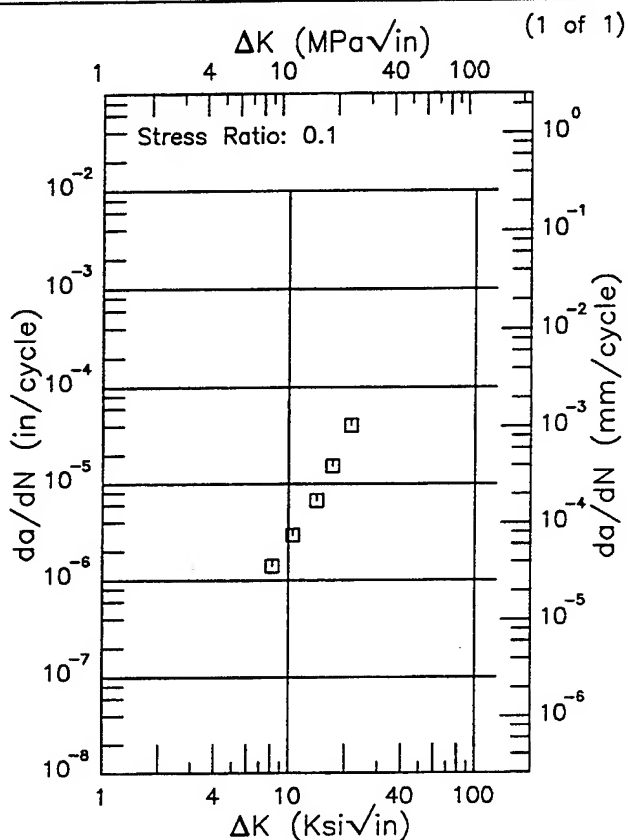


Figure 6.2.3.1.2

R | BETA C |

Condition/Ht: STA  
 Form: 0.13 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation: T-L  
 Frequency: 1 Hz  
 Environment: S.T.W.; RT

Yield Strength: 167.7 ksi  
 Ult. Strength: 183.5 ksi  
 Specimen Thk: 0.127 in.  
 Specimen Width: 6.009 in.  
 Ref: 88575



$\Delta K$  (Ksi√in)       $da/dN$  ( $10^{-6}$  in/cycle)

$\Delta K$  (Ksi√in)       $da/dN$  ( $10^{-6}$  in/cycle)

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

Figure 6.2.3.1.3

TABLE 6.3.1.1

1 of 1

**MEAN PLANE STRAIN FRACTURE TOUGHNESS  
FOR TITANIUM ALLOY BETA-III AT ROOM TEMPERATURE**

Product Form	Condition/Heat Treatment	$K_{Ic}$ (ksi $\sqrt{in}$ )									
		Specimen Orientation									
		L-T			T-L			S-L			
		Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	
Plate	1325F .25HR WQ 925F 8HR	49.8	1.2	3	---	---	---	---	---	---	---



TABLE 6.3.2.1

TITANIUM BETA III $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 ° ( $\Delta K_{Ic}^{TS}$ ) (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ (Ksi • $\sqrt{\text{in.}}$ )	$K_{Ic}$ MEAN	STAN DEV		
1325F .25HR WQ 925F 8HR	Plate	0.80	R.T.	L-T	186.0	1.503	0.750	CT	0.795	0.18	50.50	49.8	1.2	1974	91793
		0.80			186.0	1.502	0.750	CT	0.775	50.40	1974			91793	
		0.80			186.0	1.504	0.750	CT	0.763	48.40	1974			91793	
1350F 0.5 HR WQ 950F 8HR AC	Extrusion	3.00	R.T.	C-R	178.0	1.489	0.750	CT	0.773	0.24	55.20	55.1	1.8	1973	87230 (1)
		3.00			178.0	1.499	0.751	CT	0.790	53.20	1973			87230 (1)	
		3.00			178.0	1.499	0.750	CT	0.789	56.80	1973			87230 (1)	
STA-1325F WQ 1045F 8 HR	Plate	1.00	R.T.	T-L	160.0	2.000	1.005	CT	0.977	0.67	85.70	--	--	1973	88144
STA-1325F WQ 1045F 8HR (ELECTRON BEAM WELD ZONE)	Plate	1.00	R.T.	T-L	150.0	2.000	0.991	CT	0.917	0.17	42.20	--	--	1973	88144
STA-1325F WQ 1045F 8HR (HEAT AFFECTED ZONE)	Plate	1.00	R.T.	T-L	150.0	2.000	0.996	CT	0.930	0.55	76.30	--	--	1973	88144

NOTES: (1) ALPHA PRECIPITATE IN BETA MATRIX  
STRAIGHTNESS OF CRACK FRONT MAY NOT MEET ASTM E399-72 REQUIREMENTS

**This page intentionally left blank**

EF BETA III

Condition/Ht: STA  
Form: 1 in. Plate  
Specimen Type: CT  
Orientation: T-L  
Stress Ratio: 0.1

Yield Strength:  
Ult. Strength:  
Specimen Thk: 1 in.  
Specimen Width: 2.55 in.  
Ref: 88144

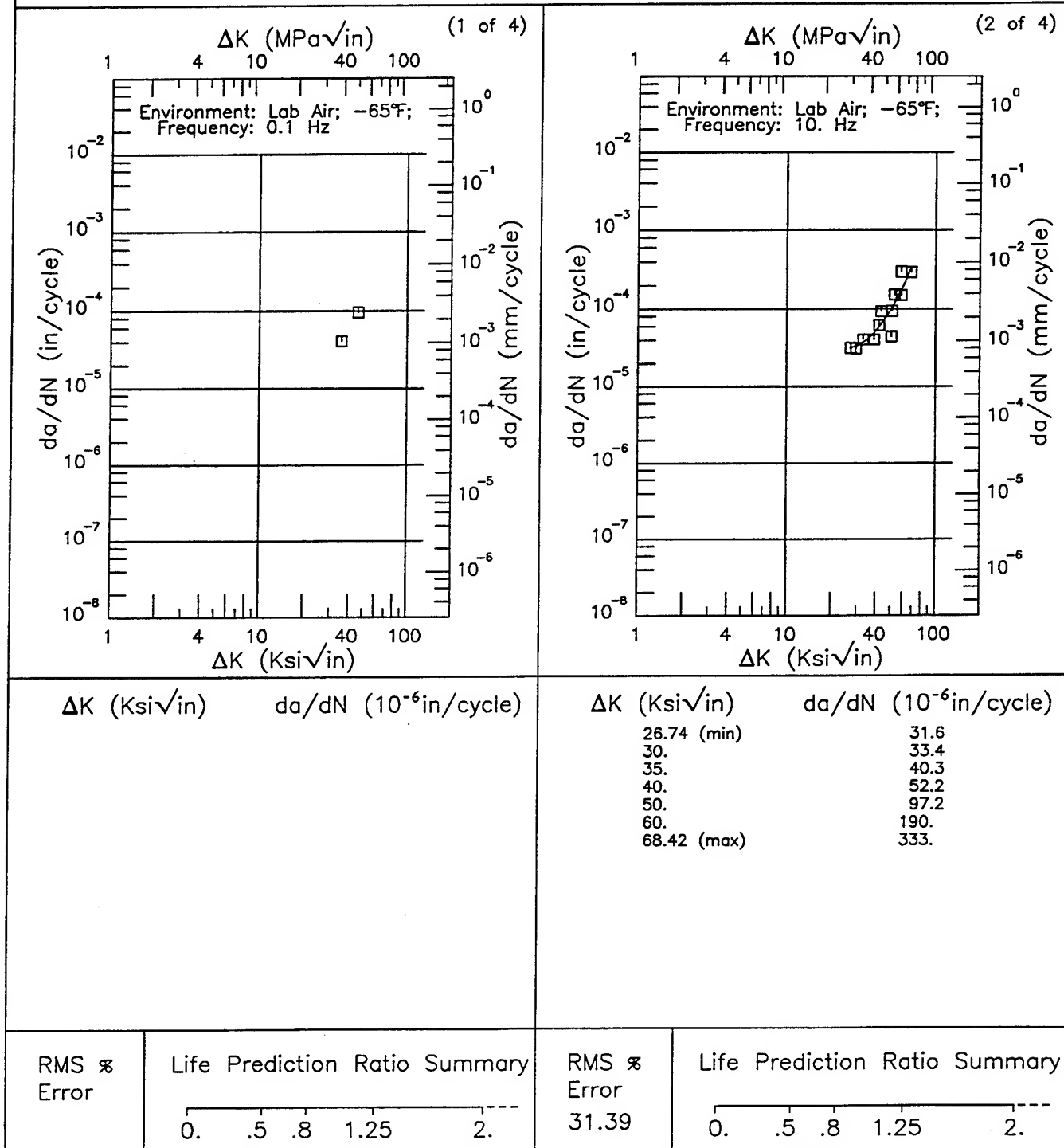


Figure 6.3.3.1.1

Condition/Ht: STA  
Form: 1 in. Plate  
Specimen Type: CT  
Orientation: T-L  
Stress Ratio: 0.1

Yield Strength:  
Ult. Strength:  
Specimen Thk: 1 in.  
Specimen Width: 2.55 in.  
Ref: 88144

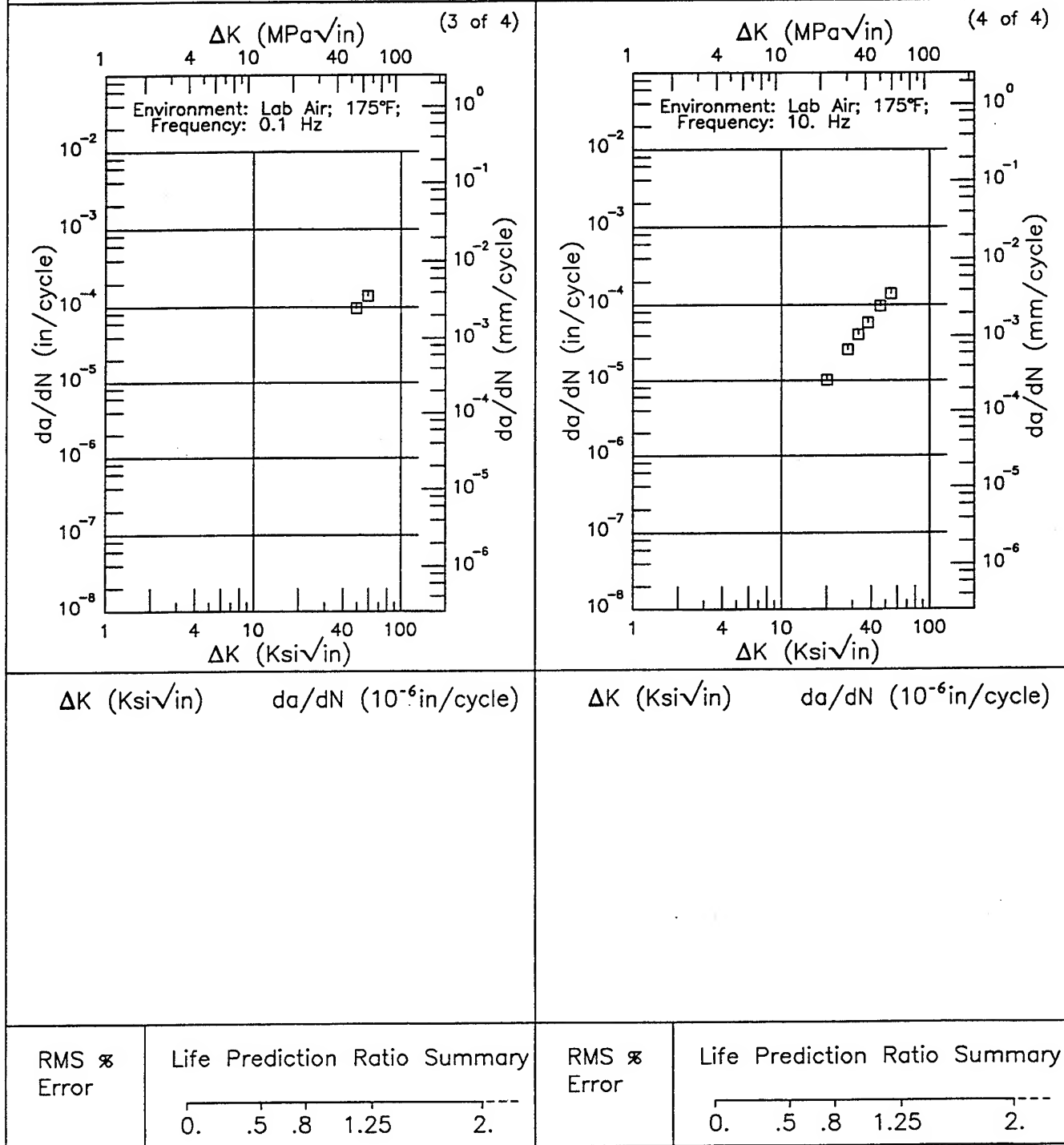
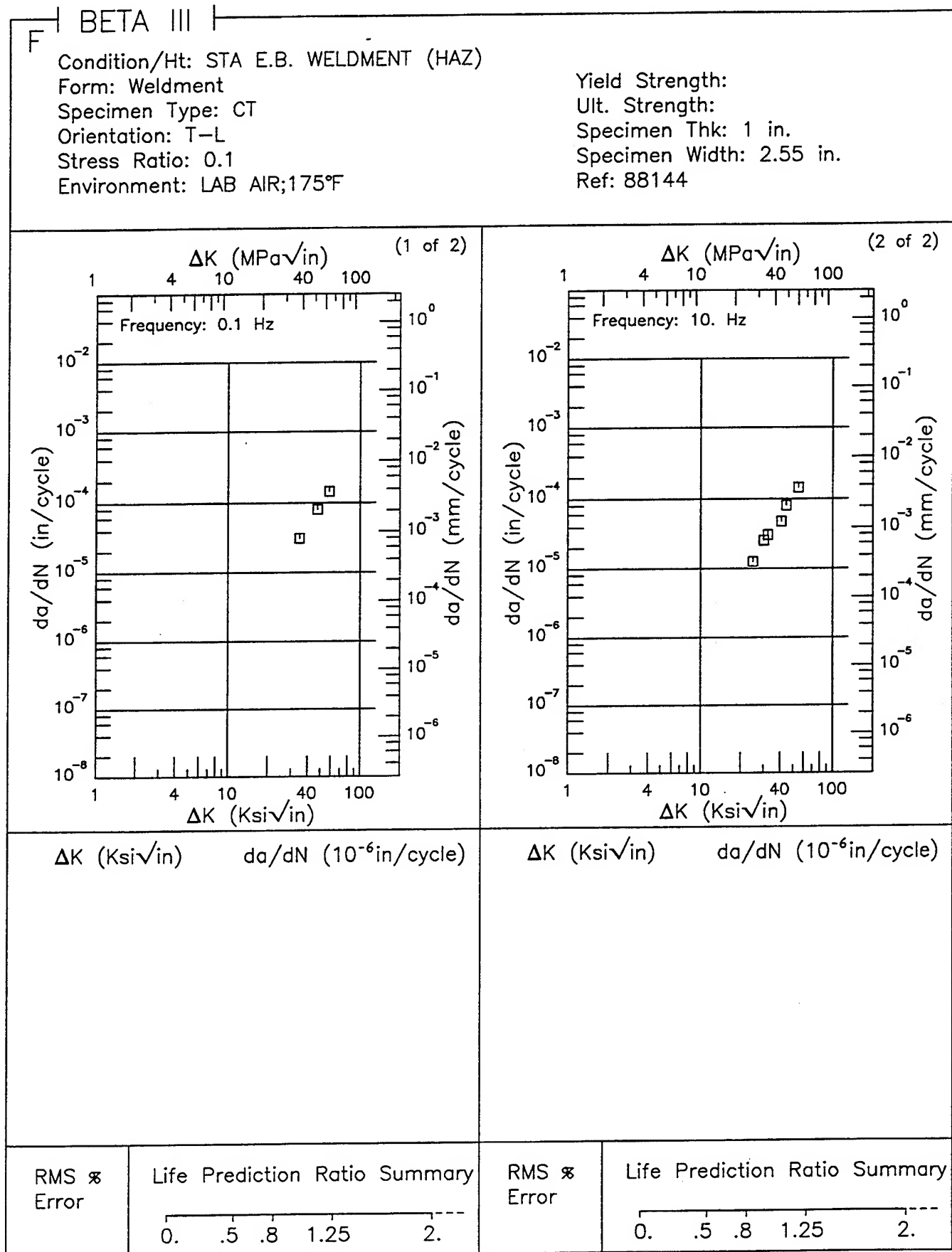


Figure 6.3.3.1.1 (Concluded)



**Figure 6.3.3.1.2**

Condition/Ht: STA E.B. WELDMENT (WELD ZONE)  
 Form: Weldment  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.1

Yield Strength:  
 Ult. Strength:  
 Specimen Thk: 1 in.  
 Specimen Width: 2.55 in.  
 Ref: 88144

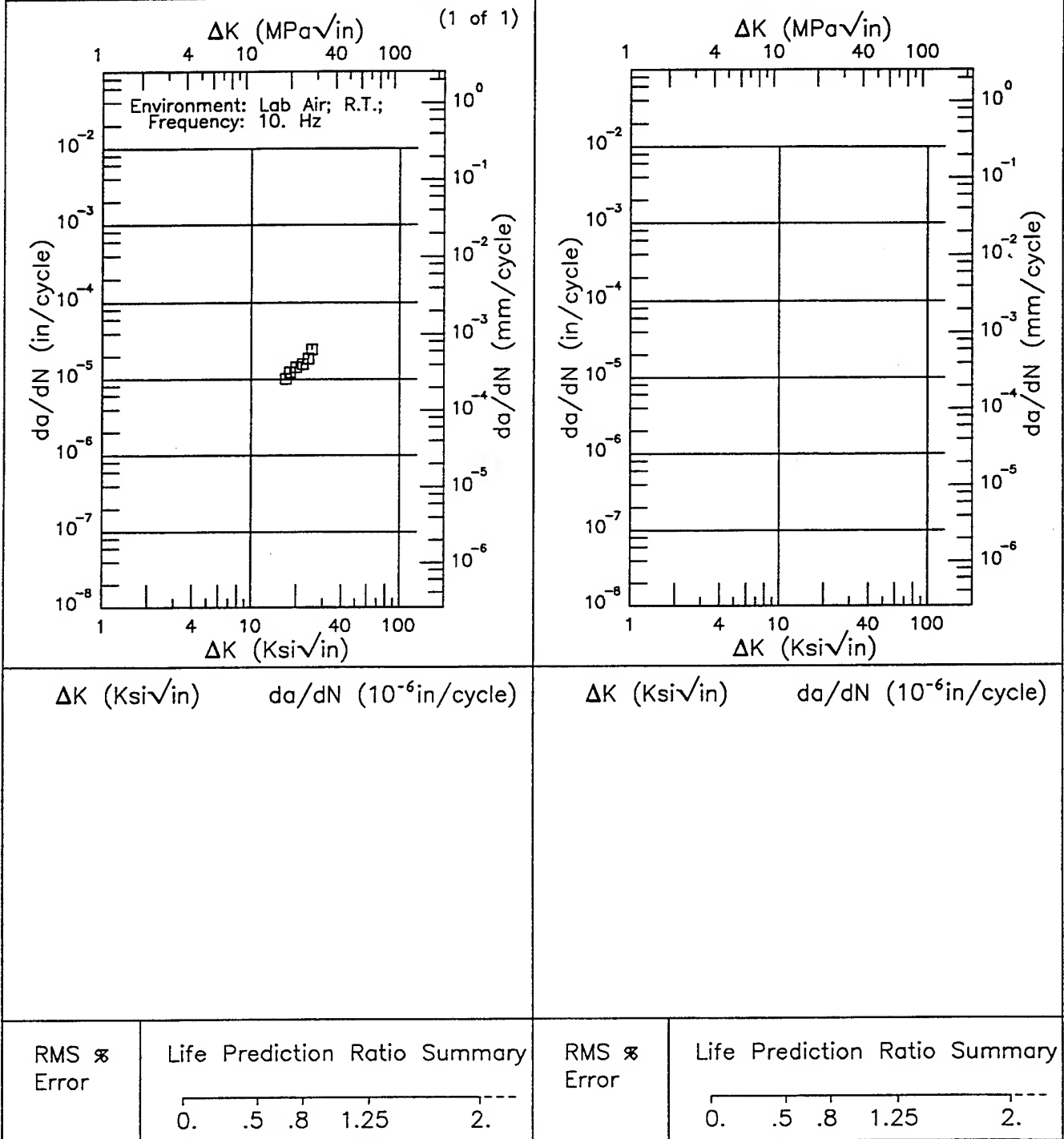
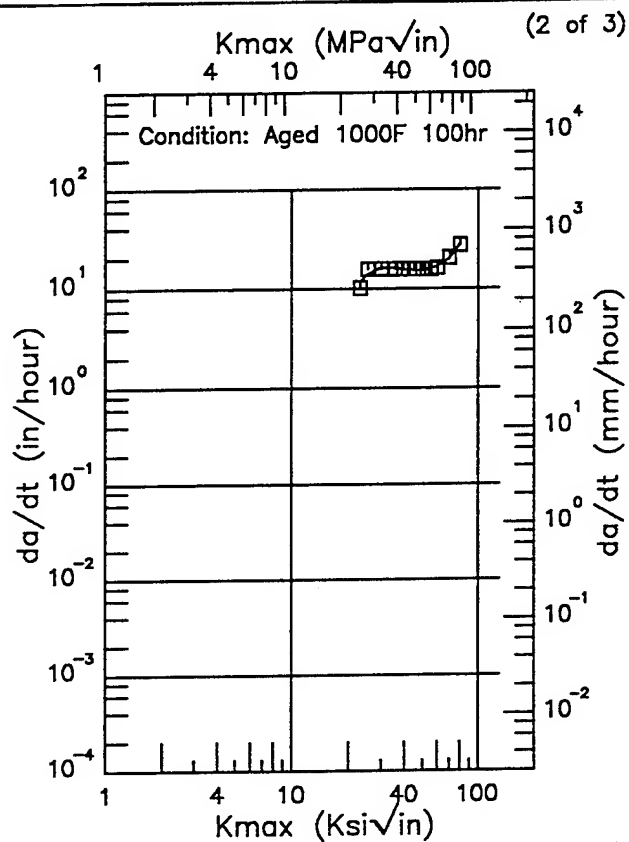
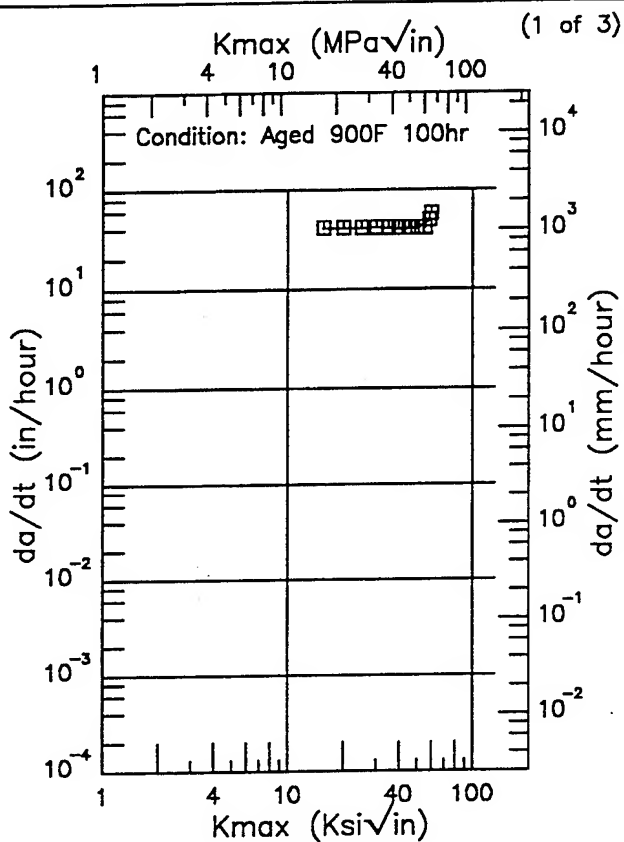


Figure 6.3.3.1.3

# BETA III

Condition/Ht:  
 Environment: 0.6M KCl; 75°F  
 Specimen Type: SENT  
 Orientation:  
 Yield Strength:  
 Ult. Strength:

Specimen Thk:  
 Specimen Width:  
 A<sub>0</sub>:  
 K<sub>Isc</sub>:  
 Ref: 82651



Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
15.50 (min)	40679.
16.	40511.
20.	40187.
25.	40656.
30.	40950.
35.	40700.
40.	39904.
50.	40560.
59.50 (max)	49207.

Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
23.00 (min)	11248.
25.	13585.
30.	16206.
35.	16046.
40.	15283.
50.	15101.
60.	16587.
70.	19711.
80.00 (max)	27111.

RMS %  
 Error  
 5.76

RMS %  
 Error  
 5.46

Figure 6.3.3.2.1

Condition/Ht:  
 Environment: 0.6M KCl; 75°F  
 Specimen Type: SENT  
 Orientation:  
 Yield Strength:  
 Ult. Strength:

Specimen Thk:  
 Specimen Width:  
 A<sub>o</sub>:  
 K<sub>Isc</sub>:  
 Ref: 82651

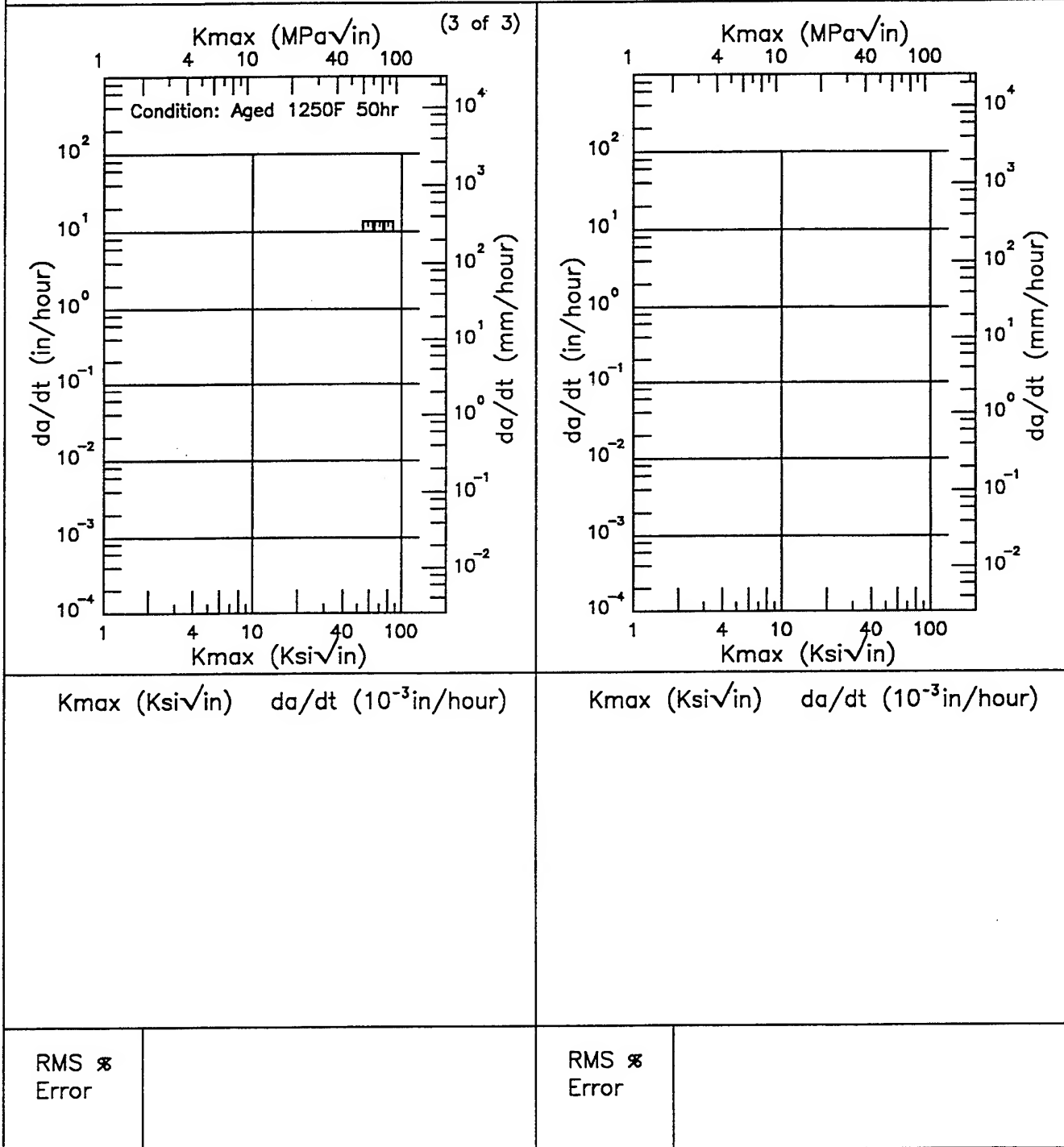


Figure 6.3.3.2.1 (Concluded)



# BETA III

Condition/Ht:  
 Environment: 0.6M KCl  
 Specimen Type: SENT  
 Orientation:  
 Yield Strength:  
 Ult. Strength:

Specimen Thk:  
 Specimen Width:  
 A<sub>0</sub>:  
 K<sub>I</sub><sub>ISCC</sub>:  
 Ref: 82651

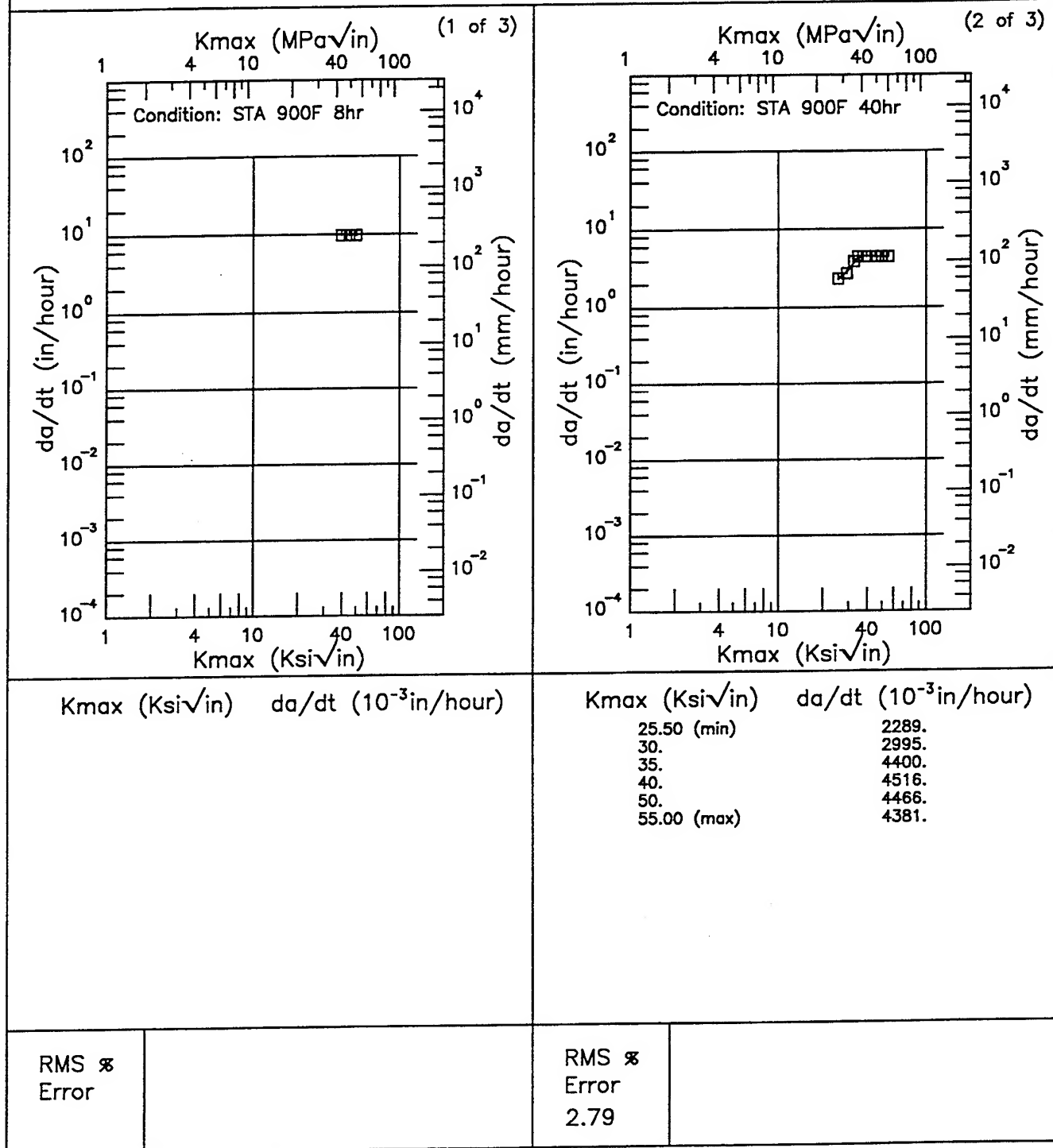
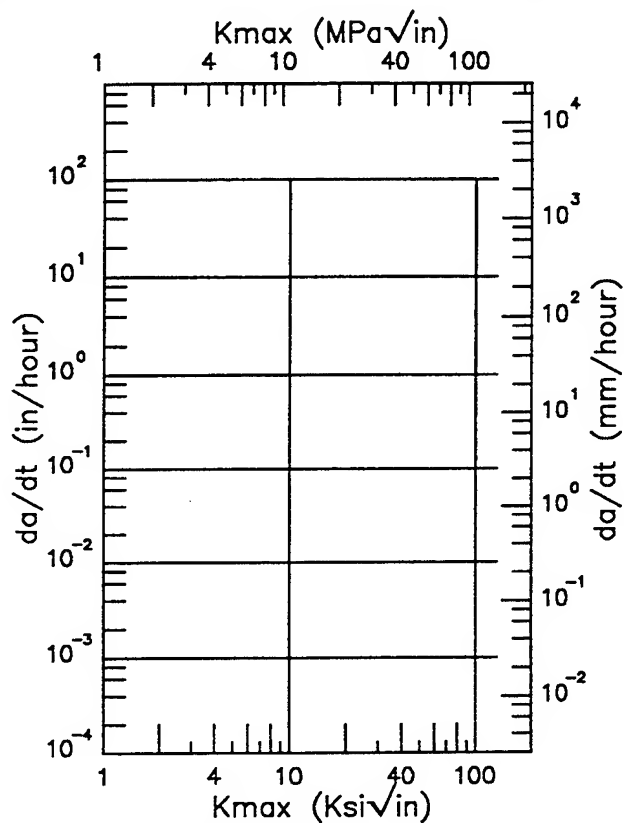


Figure 6.3.3.2.2

Specimen Thk:  
Specimen Width:  
Ao:  
K<sub>I</sub>SCC:  
Ref: 82651



K <sub>max</sub> (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
1.0	0.000000
1.5	0.000000
2.0	0.000000
2.5	0.000000
3.0	0.000000
3.5	0.000000
4.0	0.000000
4.5	0.000000
5.0	0.000000
5.5	0.000000
6.0	0.000000
6.5	0.000000
7.0	0.000000
7.5	0.000000
8.0	0.000000
8.5	0.000000
9.0	0.000000
9.5	0.000000
10.0	0.000000
10.5	0.000000
11.0	0.000000
11.5	0.000000
12.0	0.000000
12.5	0.000000
13.0	0.000000
13.5	0.000000
14.0	0.000000
14.5	0.000000
15.0	0.000000
15.5	0.000000
16.0	0.000000
16.5	0.000000
17.0	0.000000
17.5	0.000000
18.0	0.000000
18.5	0.000000
19.0	0.000000
19.5	0.000000
20.0	0.000000
20.5	0.000000
21.0	0.000000
21.5	0.000000
22.0	0.000000
22.5	0.000000
23.0	0.000000
23.5	0.000000
24.0	0.000000
24.5	0.000000
25.0	0.000000
25.5	0.000000
26.0	0.000000
26.5	0.000000
27.0	0.000000
27.5	0.000000
28.0	0.000000
28.5	0.000000
29.0	0.000000
29.5	0.000000
30.0	0.000000
30.5	0.000000
31.0	0.000000
31.5	0.000000
32.0	0.000000
32.5	0.000000
33.0	0.000000
33.5	0.000000
34.0	0.000000
34.5	0.000000
35.0	0.000000
35.5	0.000000
36.0	0.000000
36.5	0.000000
37.0	0.000000
37.5	0.000000
38.0	0.000000
38.5	0.000000
39.0	0.000000
39.5	0.000000
40.0	0.000000
40.5	0.000000
41.0	0.000000
41.5	0.000000
42.0	0.000000
42.5	0.000000
43.0	0.000000
43.5	0.000000
44.0	0.000000
44.5	0.000000
45.0	0.000000
45.5	0.000000
46.0	0.000000
46.5	0.000000
47.0	0.000000
47.5	0.000000
48.0	0.000000
48.5	0.000000
49.0	0.000000
49.5	0.000000
50.0	0.000000
50.5	0.000000
51.0	0.000000
51.5	0.000000
52.0	0.000000
52.5	0.000000
53.0	0.000000
53.5	0.000000
54.0	0.000000
54.5	0.000000
55.0	0.000000
55.5	0.000000
56.0	0.000000
56.5	0.000000
57.0	0.000000
57.5	0.000000
58.0	0.000000
58.5	0.000000
59.0	0.000000
59.5	0.000000
60.0	0.000000
60.5	0.000000
61.0	0.000000
61.5	0.000000
62.0	0.000000
62.5	0.000000
63.0	0.000000
63.5	0.000000
64.0	0.000000
64.5	0.000000
65.0	0.000000
65.5	0.000000
66.0	0.0000

RMS Error

6-57

TABLE 6.3.3.3  
K<sub>Isc</sub> SUMMARY FOR TITANIUM ALLOY BETA III

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	K <sub>Q</sub> (Ksi√in)	K <sub>I<sub>sc</sub></sub> (Ksi√in)	Test Time (min)	Test Date	Reference
						Design	Width (in)	Thick (in)							
Beta Stab +Aged 900F 1HR	S	R.T.	---	---	.6M KCl -1500MV	SENT	---	---	---	---	65	55*	---	1970	82651
					.6M KCl -1000MV	SENT	---	---	---	65	28*	---	1970	82651	
					.6M KCl -750MV	SENT	---	---	---	65	16*	---	1970	82651	
					.6M KCl -500MV	SENT	---	---	---	65	14*	---	1970	82651	
					.6M KCl 0 MV	SENT	---	---	---	65	21*	---	1970	82651	
					.6M KCl +500MV	SENT	---	---	---	65	24*	---	1970	82651	
					.6M KCl +1000MV	SENT	---	---	---	65	25*	---	1970	82651	

\* specimen thickness does not meet minimum requirements of  $2.5 \left( \frac{K_{Isc}^2}{\sigma_y} \right)$

**This page intentionally left blank**



TABLE 6.5.2.1

1 of 1

TITANIUM CORONA 5 K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5° (K <sub>ITVS</sub> ) <sup>a</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksi √in.)	K <sub>Ic</sub> MEAN	STAN DEV		
ALPHA-BETA FORGED & LOW ANNEAL & AGE	Forging	2.00	R.T.	---	135.3	---	2.000	---	---	0.57	64.84	---	---	---	R1005

TABLE 6.6.1.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**IMI-834 AT ROOM TEMPERATURE**

ORIENTATION: C-R

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)				
				$\Delta K$ Level (Ksi $\sqrt{in}$ )				
1864F 2HRS; OQ TO R.T.; AGE 1161F 2HRS	DISK	0.1	1	2.5	5.0	10.0	20.0	50.0
								100.0
						0.22	7.72	

**This page intentionally left blank**



F | IMI-834 |

Condition/Ht: 1864F 2HRS; OQ TO R.T.; AGE 1161F 2HRS

Form: Disk

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.1

Environment: LAB AIR; 1099°F

Yield Strength: 100 ksi

Ult. Strength:

Specimen Thk: 0.198 in.

Specimen Width: 0.799 in.

Ref: WL010

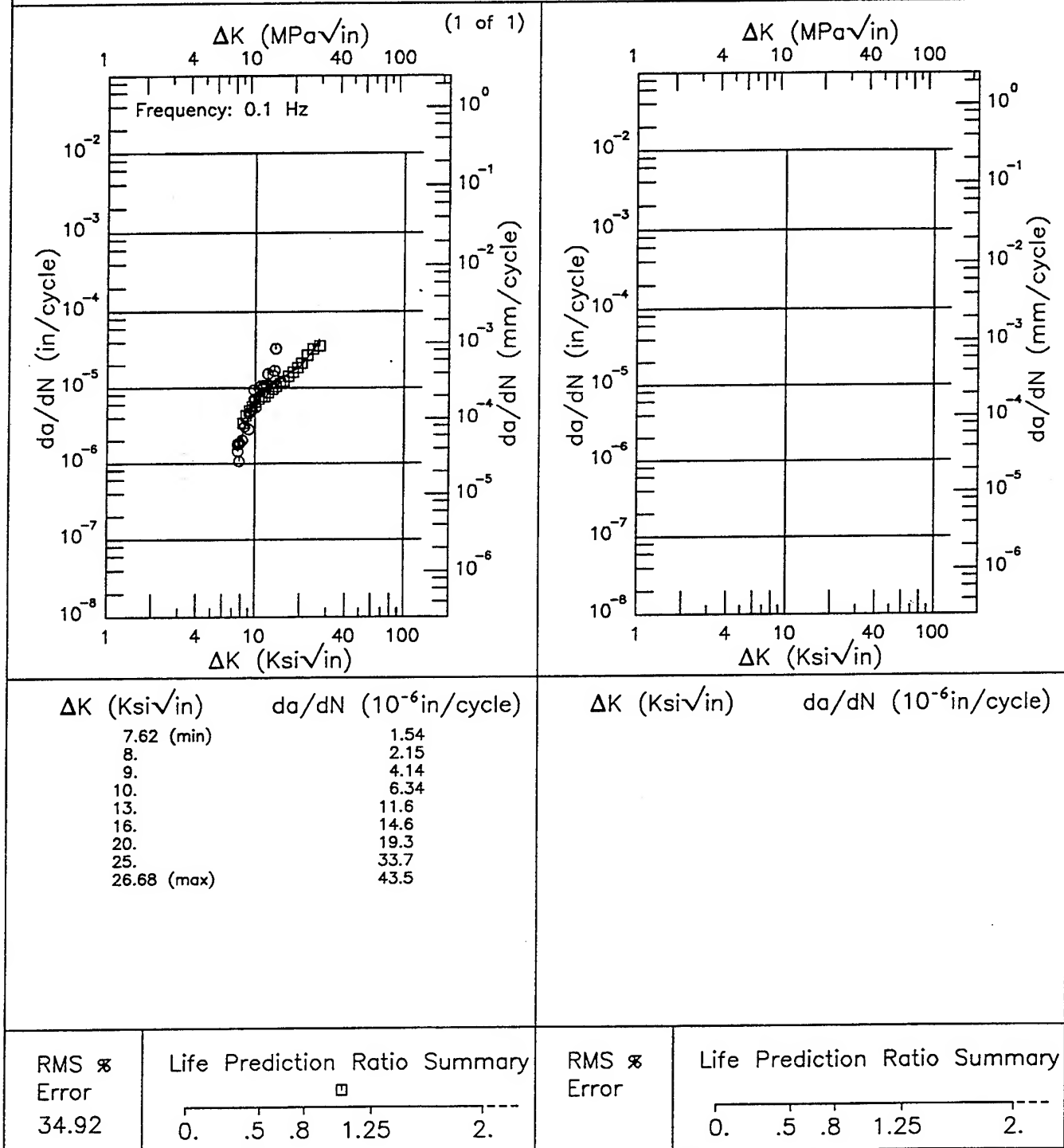


Figure 6.6.3.1.1

**This page intentionally left blank**

IMI-834

Condition/Ht: 1864F 2HRS; OQ TO R.T.; AGE 1161F 2HRS

Form: Disk

Specimen Type: CT

Orientation: C-R

Stress Ratio: 0.1

Frequency: 1 Hz

Yield Strength: 75 - 138 ksi

Ult. Strength:

Specimen Thk: 0.171 - 0.196 in.

Specimen Width: 0.796 - 0.8 in.

Ref: WL010

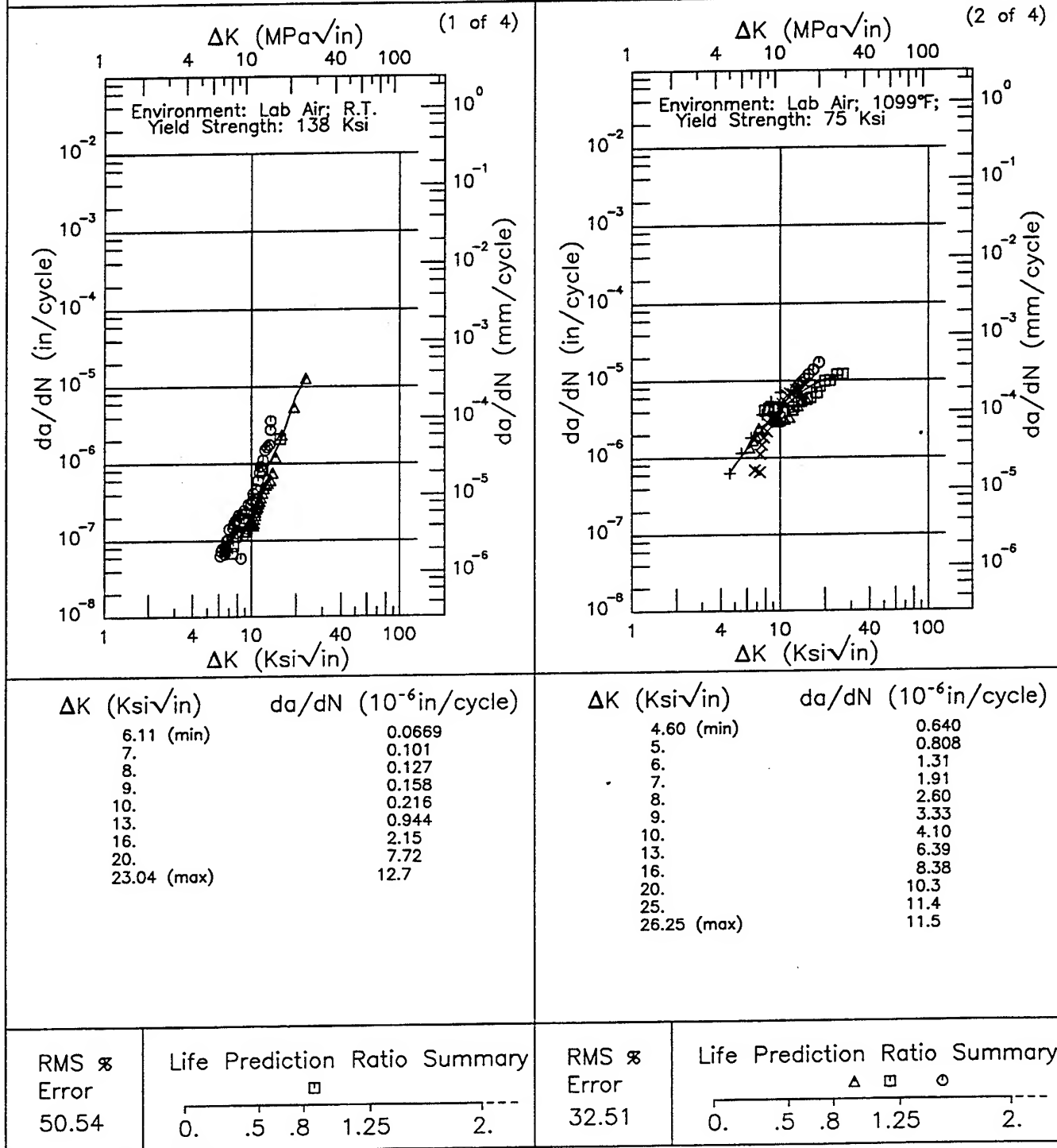


Figure 6.6.3.1.2

Condition/Ht: 1864F 2HRS; OQ TO R.T.; AGE 1161F 2HRS  
 Form: Disk  
 Specimen Type: CT  
 Orientation: C-R  
 Stress Ratio: 0.1  
 Frequency: 1 Hz

Yield Strength: 75 - 138 ksi  
 Ult. Strength:  
 Specimen Thk: 0.171 - 0.196 in.  
 Specimen Width: 0.796 - 0.8 in.  
 Ref: WL010

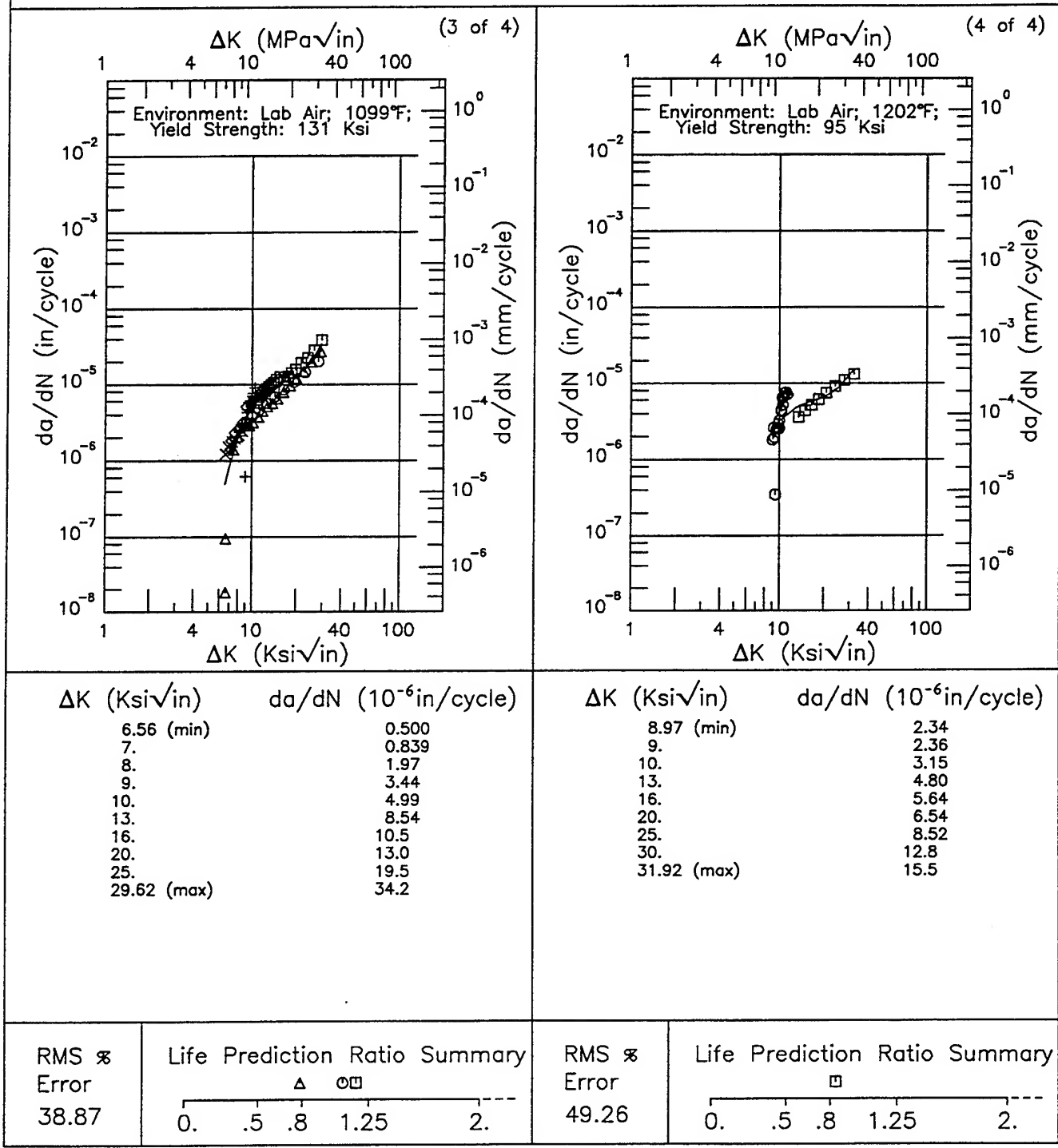


Figure 6.6.3.1.2 (Concluded)

**TABLE 6.7.1.1**  
**MEAN PLANE STRAIN FRACTURE TOUGHNESS**  
**FOR TITANIUM ALLOY TI-\* AT ROOM TEMPERATURE**

Product Form	Condition/Heat Treatment	$K_{Ic}$ (ksi $\sqrt{in}$ )							
		Specimen Orientation							
		L-T		T-L		S-L			
		Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev
Plate	1740F 1 HR AC	61.6	1.6	3	---	---	---	---	---
	STA-1740F 1 HR AC 1000F 8HR AC	55.3	1.5	3	---	---	---	---	---

TABLE 6.8.1.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-10-2-3 AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $K_{SI}/in$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
UNSPECIFIED	UNSPECIFIED	0.05	10		0.48				
		0.1	10			1.16			
		0.33	10		0.65				

R

Ti-10-2-3

Condition/Ht:

Form:

Specimen Type: CT

Orientation: L-T

Frequency: 10 Hz

Environment: LAB AIR; RT

Yield Strength:

Ult. Strength:

Specimen Thk: 0.244 - 0.25 in.

Specimen Width: 1.991 - 2.006 in.

Ref: NC005

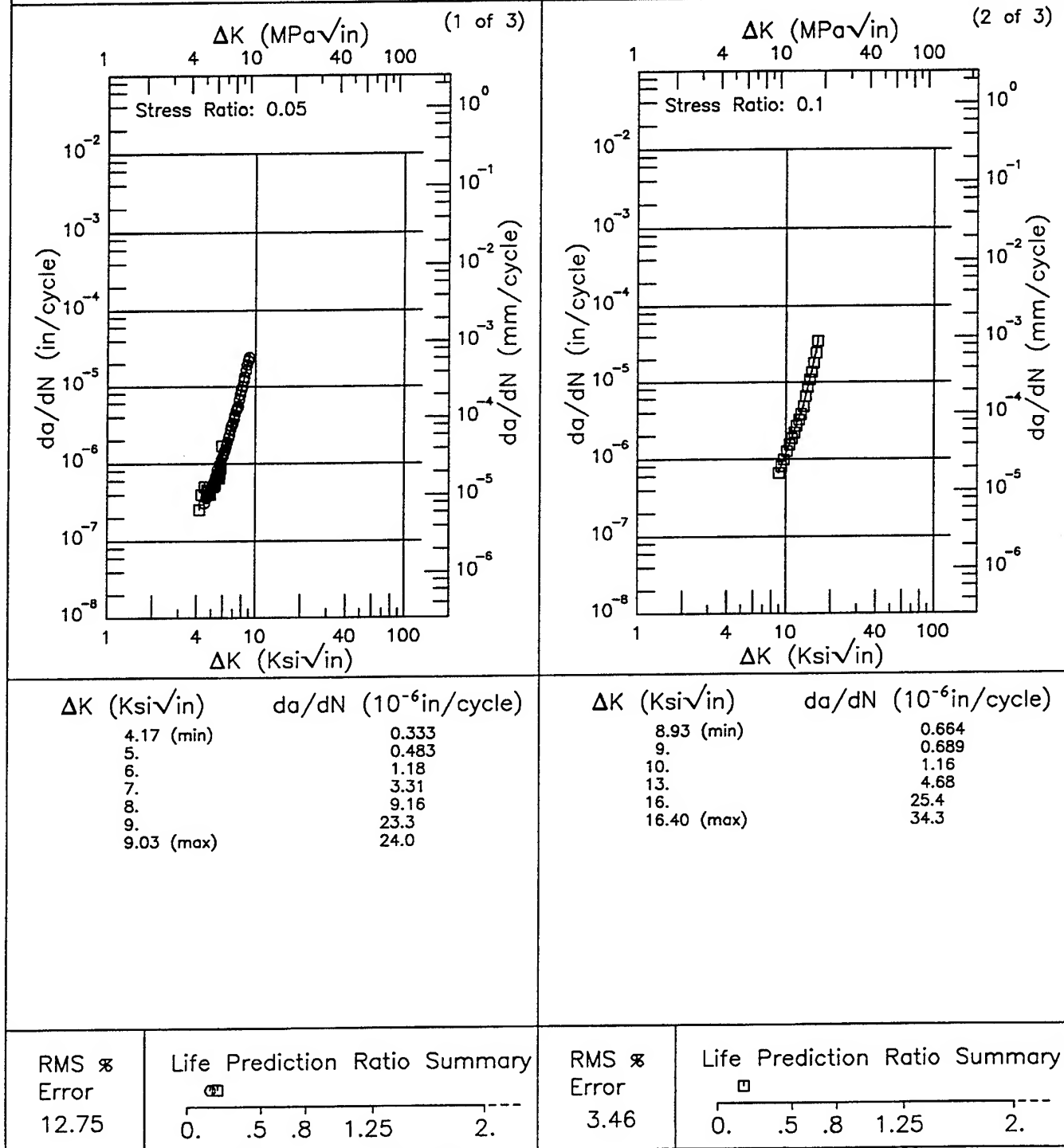


Figure 6.8.3.1

Condition/Ht:  
Form:  
Specimen Type: CT  
Orientation: L-T  
Frequency: 10 Hz  
Environment: LAB AIR; RT

Yield Strength:  
Ult. Strength:  
Specimen Thk: 0.244 - 0.25 in.  
Specimen Width: 1.991 - 2.006 in.  
Ref: NC005

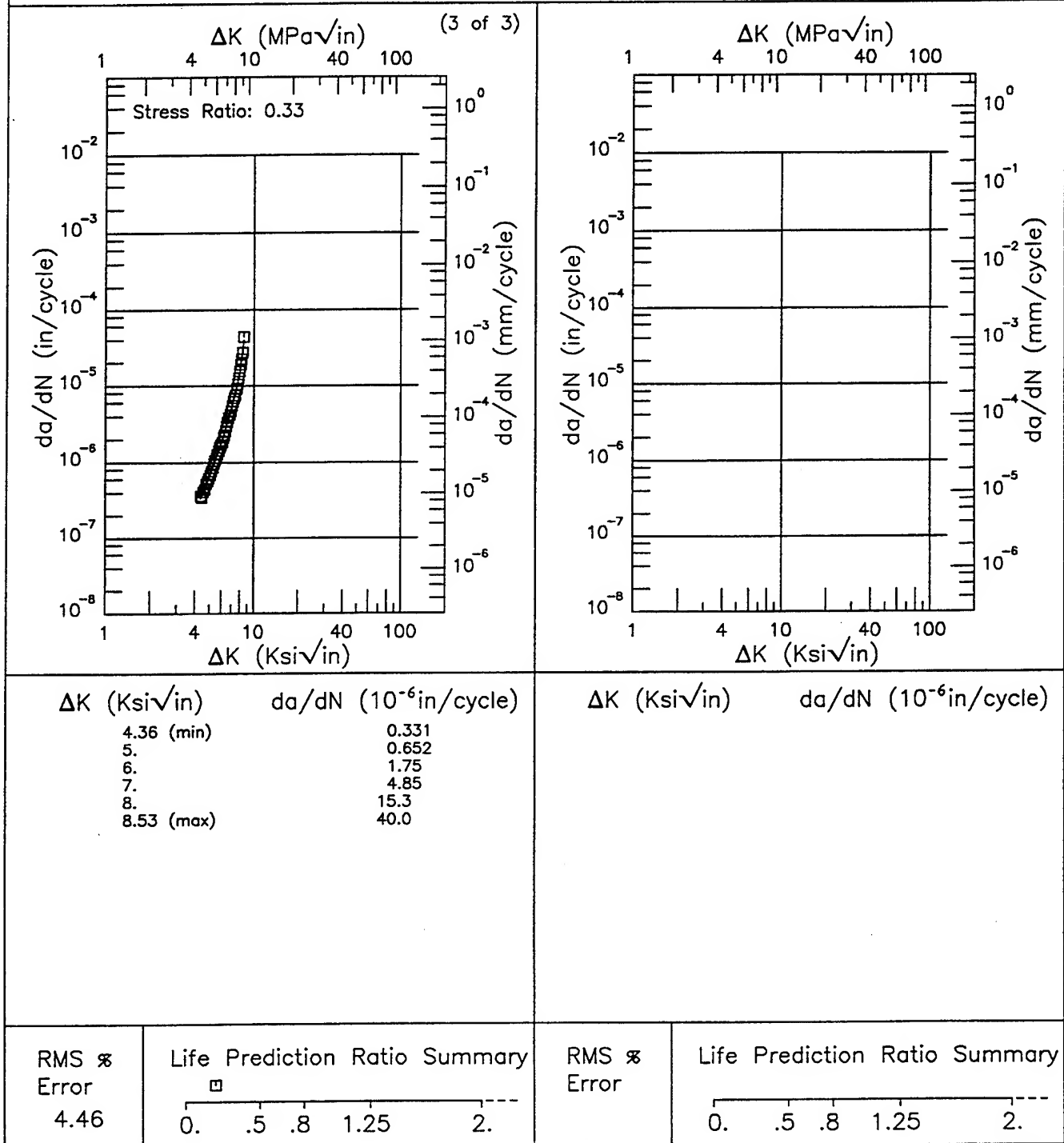


Figure 6.8.3.1 (Concluded)



**TABLE 6.9.3.3**  
**K<sub>Isc</sub> SUMMARY FOR TITANIUM ALLOY Ti-4Al-3Mo-1V**

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	K <sub>Q</sub> (Ksi√in)	K <sub>Isc</sub> (Ksi√in)	Test Time (min)	Test Date	Reference
						Design	Width (in)	Thick (in)							
Mill Annealed	P	R.T.	L-S	---	3.5% NaCl	---	---	---	0.5	---	117	105*	---	1969	75386

\* specimen thickness does not meet minimum requirements of  $2.5 \left( \frac{K_{Isc}}{\sigma_y} \right)^2$

1 of 1

TABLE 6.10.1.2.1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-5-2.5 ELI AT ROOM TEMPERATURE**

ORIENTATION: R-C

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
UNSPECIFIED	DISK	0.05	0.1				11.41		
		0.05	10				11.62	142.07	
		0.5	0.1			2.35	16.79		
		0.5	10			2.76	17.77		

TABLE 6.10.1.2.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-5-2.5 ELI AT ROOM TEMPERATURE**

ORIENTATION: C-R

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
UNSPECIFIED	DISK	0.05	0.1				12.29		
		0.05	10		1.88	19.49	261.66	108.63	
		0.5	0.1			2.79	15.32		
		0.5	10			2.81	24.16		

1 of 1

TABLE 6.10.1.2.3

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-5-2.5 ELI AT ROOM TEMPERATURE**

ENVIRONMENT: Lab Air

ORIENTATION: CS

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
UNSPECIFIED	DISK	0.05	10					101.63	
		0.5	0.1			0.9	7.78		
		0.5	10			0.48	8.85		

TABLE 6.10.1.2.4

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-5-2.5 ELI AT ROOM TEMPERATURE**

ORIENTATION: SC			ENVIRONMENT: Lab Air									
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)								
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )								
				2.5	5.0	10.0	20.0	50.0	100.0			
UNSPECIFIED	DISK	0.05	0.1				9.9	200.55				
		0.05	10				10.05	196.41				
		0.5	0.1			1.8	16.77					
		0.5	10			3	18.45					

TABLE 6.10.1.2.5

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-5-2.5 ELI AT ROOM TEMPERATURE**

ORIENTATION: RS ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $Ksi/\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
UNSPECIFIED	DISK	0.05	0.1			0.44	3.78		
		0.05	10			0.08	3.48	71.92	
		0.5	10			0.93	13.57		

TABLE 6.10.1.2.6

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-5-2.5 ELI AT ROOM TEMPERATURE**

ORIENTATION: SR

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{in}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
UNSPECIFIED	DISK	0.05	0.1				8.45		
		0.05	10				7.15	194.49	
		0.5	0.1			1.9	14.85		
		0.5	10			1.89	20.85		

**This page intentionally left blank**



R

Ti-5-2.5 ELI

Condition/Ht:

Form: 3 in. Disk

Specimen Type: WOL

Orientation: R-C

Frequency: 0.1 Hz

Environment: LIQUID HYDROGEN; -423°F

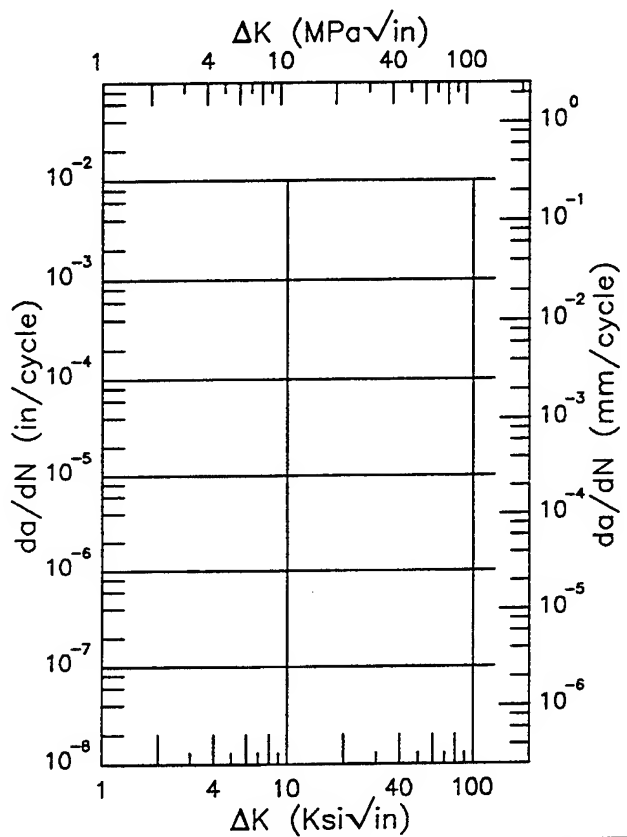
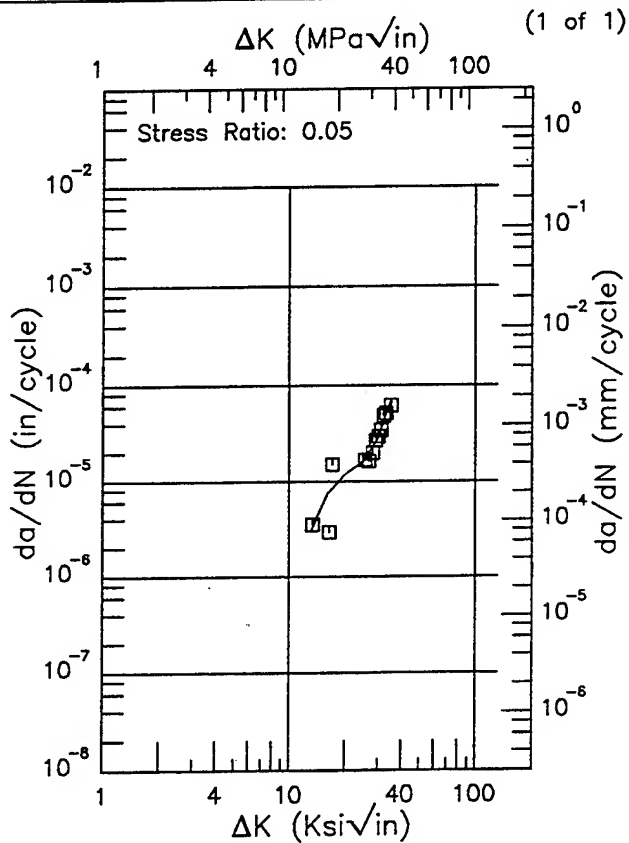
Yield Strength: 200 ksi

Ult. Strength: 211.1 ksi

Specimen Thk: 0.744 in.

Specimen Width: 2.002 in.

Ref: LG005



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
13.30 (min)	3.15
16.	7.47
20.	11.8
25.	16.4
30.	28.3
35.	69.1
35.20 (max)	72.1

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
--------------------------------------	-----------------------------------

RMS %  
Error  
30.70

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.10.3.1.1

Condition/Ht:  
 Form: 3 in. Disk  
 Specimen Type: WOL  
 Orientation: R-C  
 Frequency: 10 Hz  
 Environment: LIQUID HYDROGEN; -423°F

Yield Strength: 200 ksi  
 Ult. Strength: 211.1 ksi  
 Specimen Thk: 0.745 - 0.748 in.  
 Specimen Width: 2.003 - 2.011 in.  
 Ref: LG005

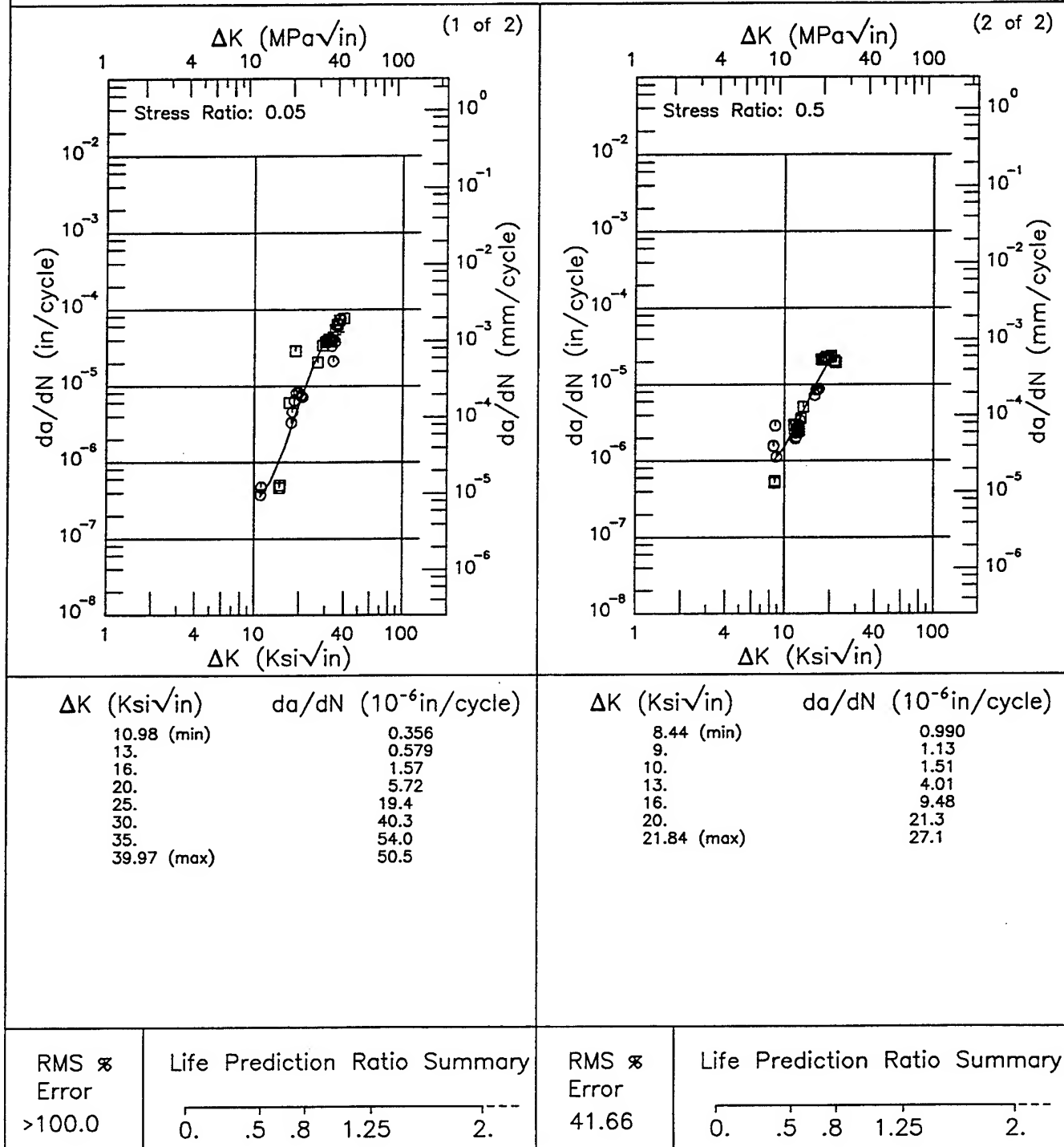


Figure 6.10.3.1.2

R

Ti-5-2.5 ELI

Condition/Ht:

Form: 3 in. Disk

Specimen Type: WOL

Orientation: R-C

Frequency: 0.1 Hz

Environment: LAB AIR; RT

Yield Strength: 113.6 ksi

Ult. Strength: 120 ksi

Specimen Thk: 0.746 - 0.749 in.

Specimen Width: 2.004 - 2.013 in.

Ref: LG005

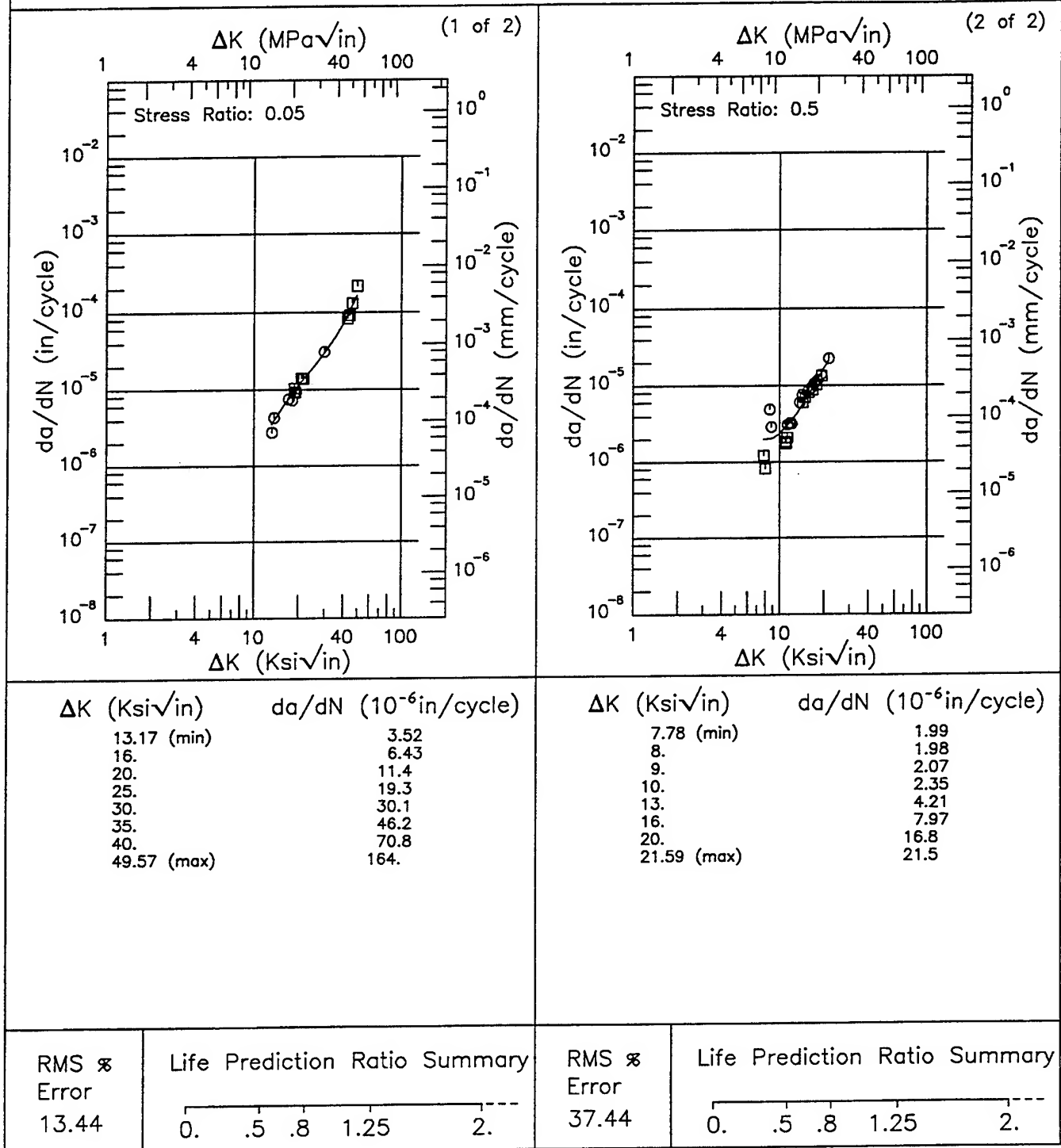


Figure 6.10.3.1.3

Condition/Ht:  
Form: 3 in. Disk  
Specimen Type: WOL  
Orientation: R-C  
Frequency: 10 Hz  
Environment: LAB AIR; RT

Yield Strength: 113.6 ksi  
Ult. Strength: 120 ksi  
Specimen Thk: 0.745 - 0.749 in.  
Specimen Width: 2 - 2.005 in.  
Ref: LG005

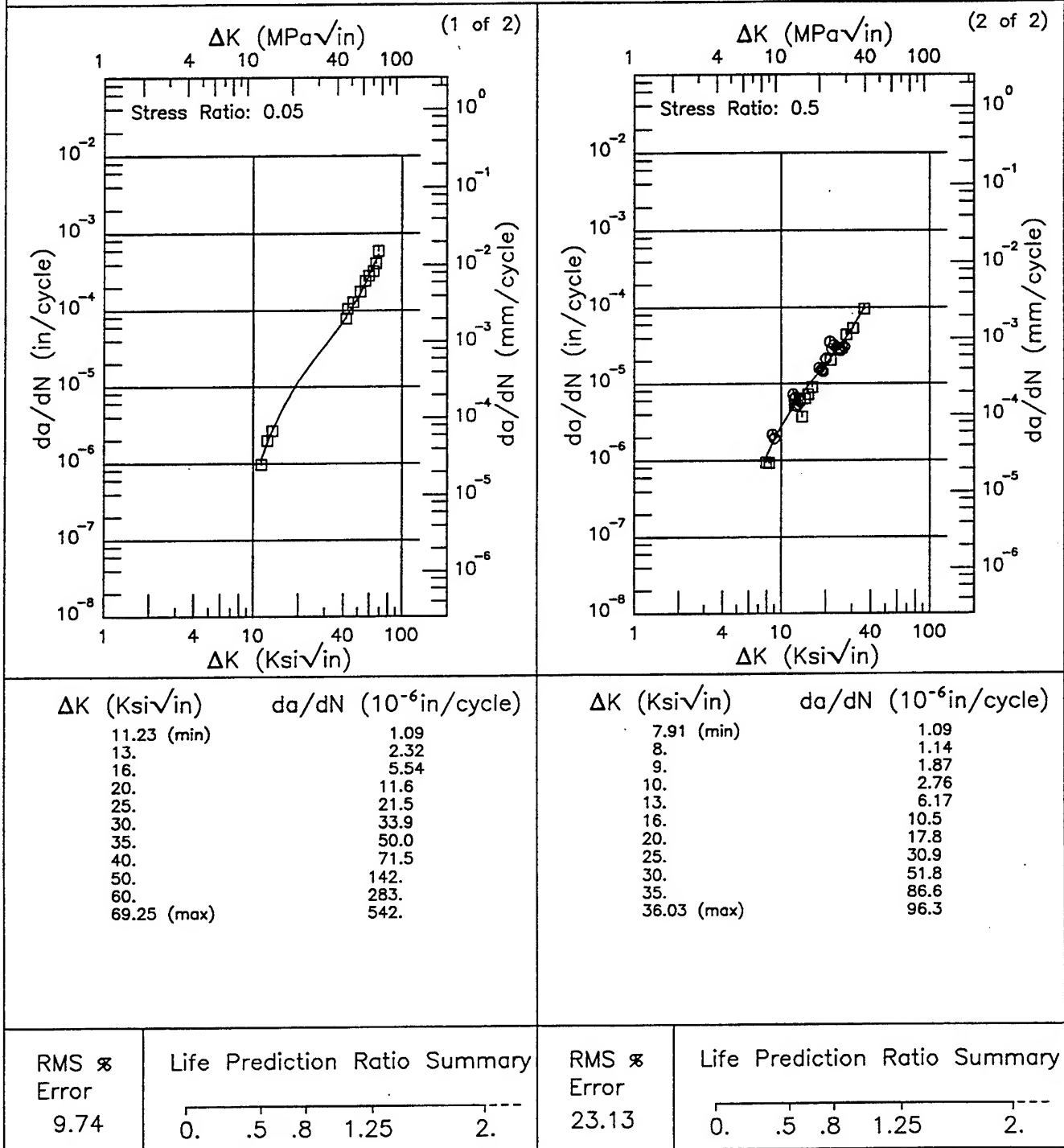
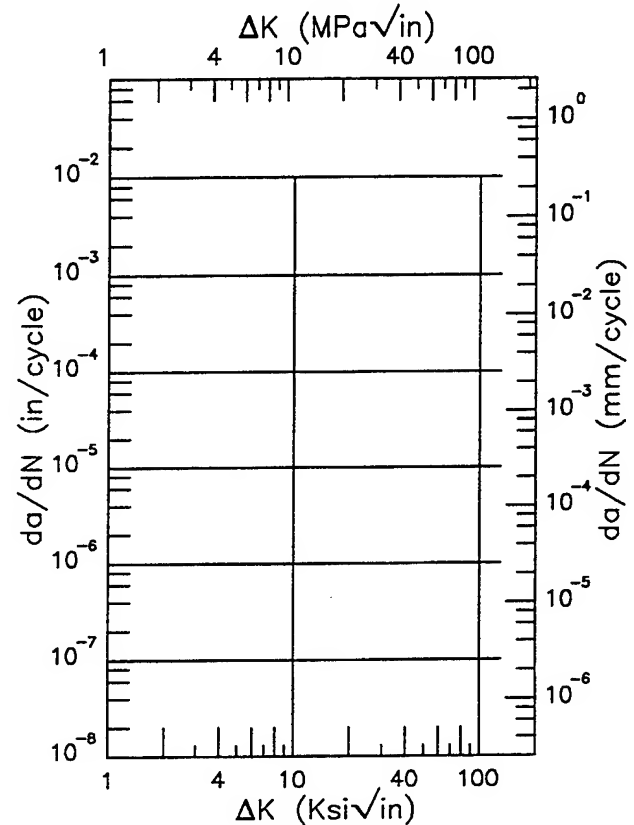
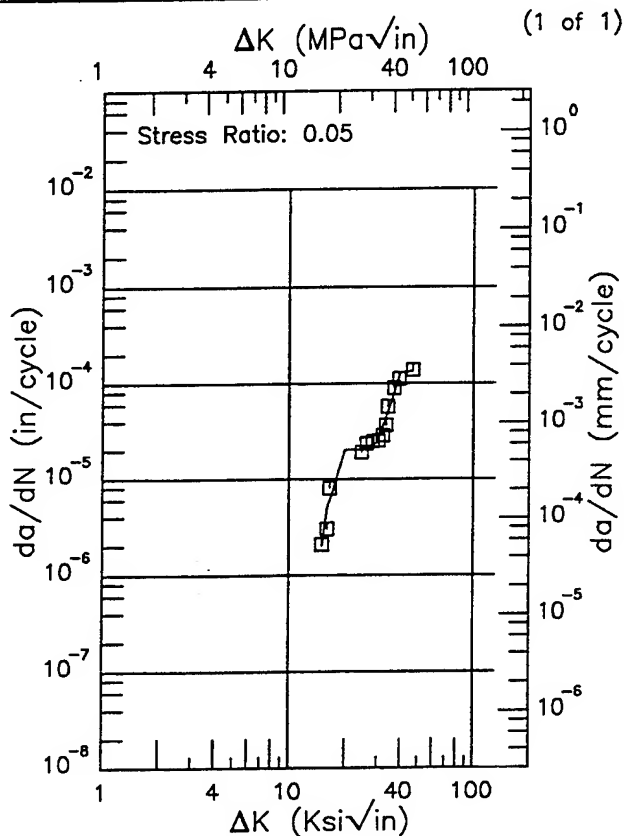


Figure 6.10.3.1.4

R | Ti-5-2.5 ELI |

Condition/Ht:  
 Form: 3 in. Disk  
 Specimen Type: WOL  
 Orientation: C-R  
 Frequency: 0.1 Hz  
 Environment: LIQUID HYDROGEN; -423°F

Yield Strength: 200 ksi  
 Ult. Strength: 211.1 ksi  
 Specimen Thk: 0.749 in.  
 Specimen Width: 2.004 in.  
 Ref: LG005



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
14.99 (min)	2.03
16.	5.06
20.	20.2
25.	20.4
30.	24.5
35.	58.2
40.	130.
46.57 (max)	135.

ΔK (Ksi√in)      da/dN (10<sup>-6</sup>in/cycle)

RMS %  
 Error  
 15.84

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
 Error

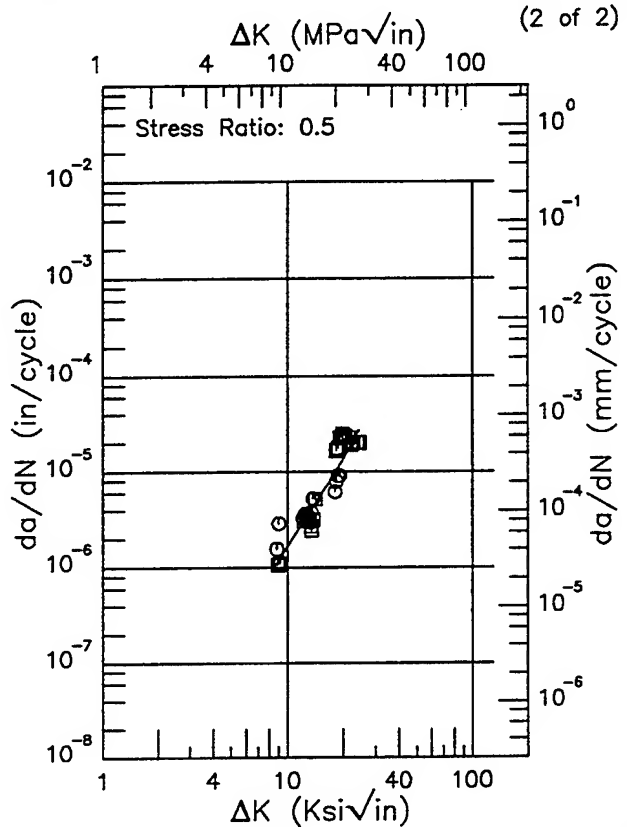
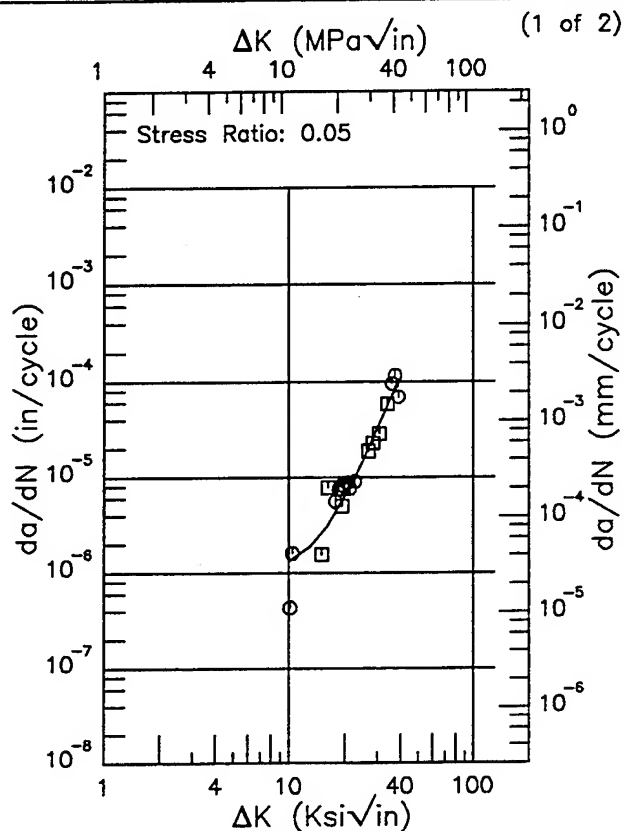
Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 6.10.3.1.5

Condition/Ht:  
 Form: 3 in. Disk  
 Specimen Type: WOL  
 Orientation: C-R  
 Frequency: 10 Hz  
 Environment: LIQUID HYDROGEN; -423°F

Yield Strength: 200 ksi  
 Ult. Strength: 211.1 ksi  
 Specimen Thk: 0.744 - 0.747 in.  
 Specimen Width: 2.004 - 2.008 in.  
 Ref: LG005



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
10.10 (min)	1.34
13.	1.87
16.	3.08
20.	6.32
25.	15.0
30.	32.7
35.	65.4
38.83 (max)	105.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.73 (min)	1.08
9.	1.19
10.	1.65
13.	3.62
16.	6.73
20.	13.6
24.45 (max)	27.3

RMS %  
 Error  
 44.37

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2.---

RMS %  
 Error  
 41.95

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2.---

Figure 6.10.3.1.6

R

Ti-5-2.5 ELI

Condition/Ht:

Form: 3 in. Disk

Specimen Type: WOL

Orientation: C-R

Frequency: 0.1 Hz

Environment: LAB AIR; RT

Yield Strength: 113.6 ksi

Ult. Strength: 120 ksi

Specimen Thk: 0.745 - 0.748 in.

Specimen Width: 2.004 - 2.008 in.

Ref: LG005

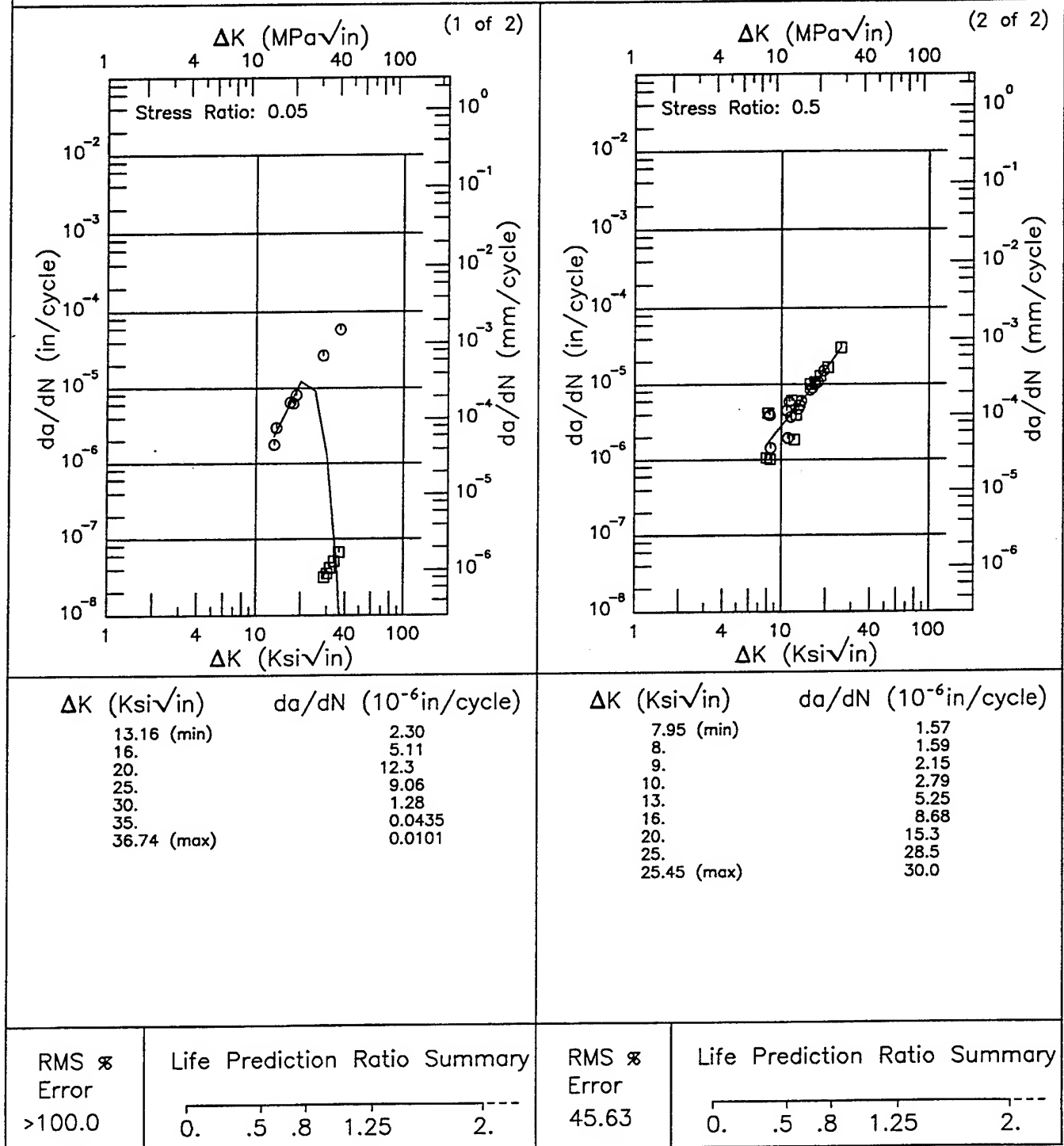


Figure 6.10.3.1.7

Condition/Ht:  
Form: 3 in. Disk  
Specimen Type: WOL  
Orientation: C-R  
Frequency: 10 Hz  
Environment: LAB AIR; RT

Yield Strength: 113.6 ksi  
Ult. Strength: 120 ksi  
Specimen Thk: 0.744 - 0.753 in.  
Specimen Width: 2.002 - 2.01 in.  
Ref: LG005

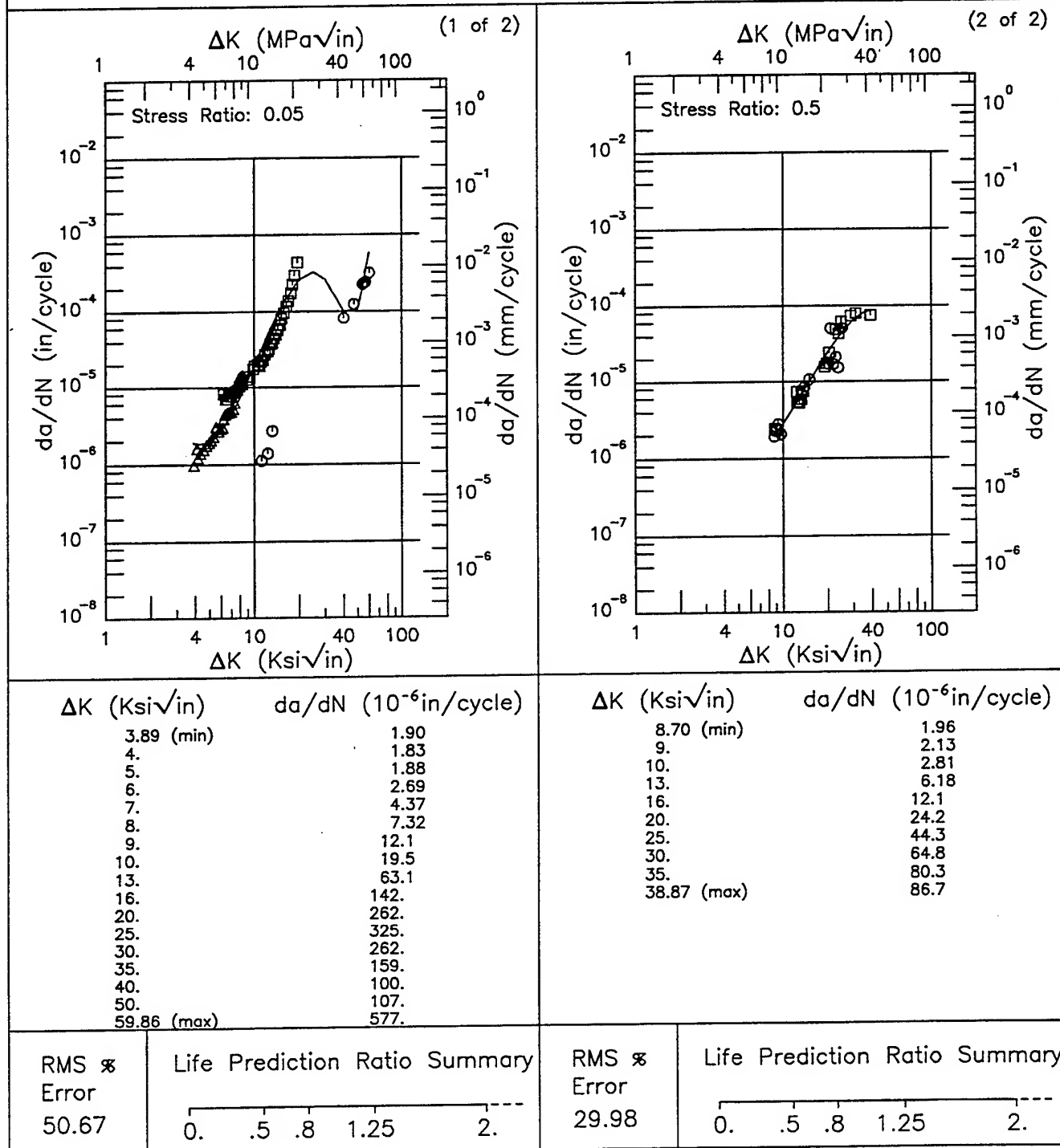


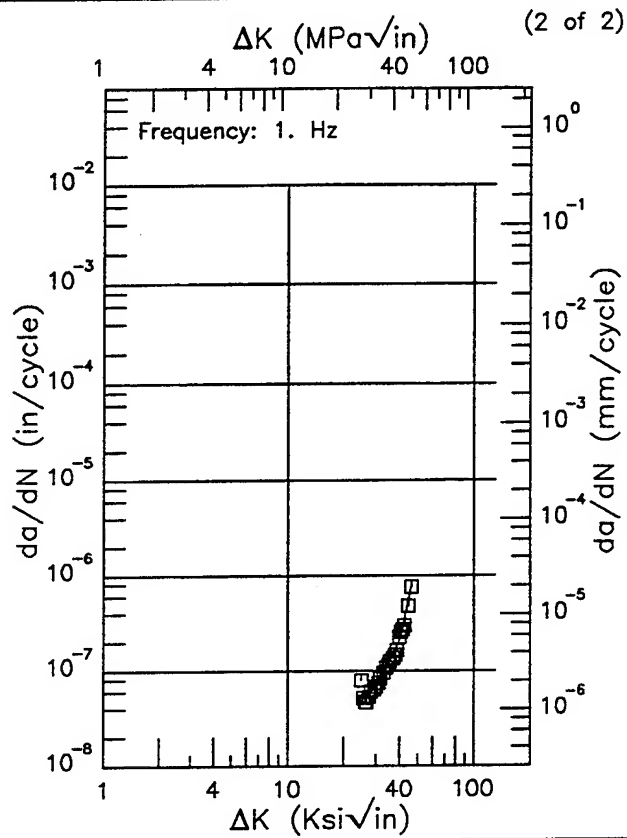
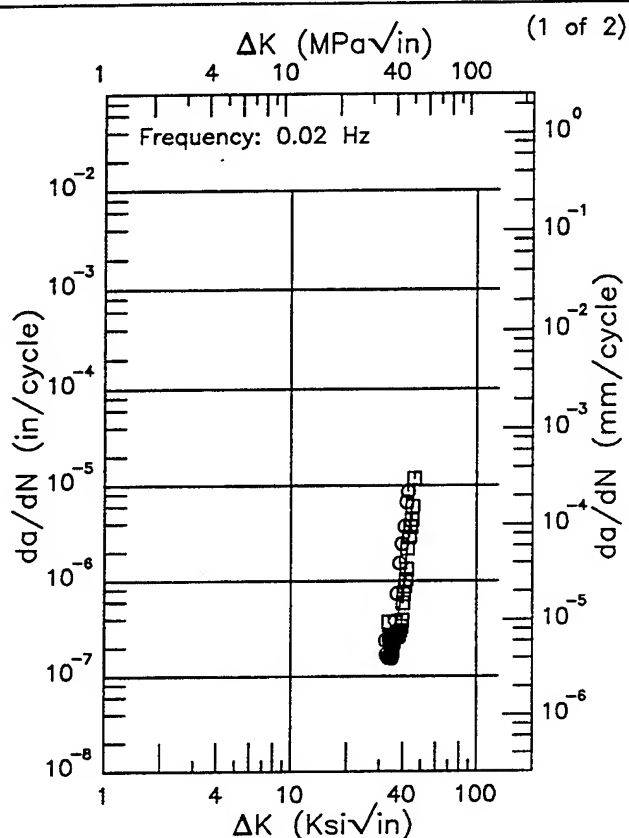
Figure 6.10.3.1.8



F | Ti-5-2.5 ELI |

Condition/Ht:  
Form: 3 in. Disk  
Specimen Type: WOL  
Orientation: C-R  
Stress Ratio: 0.5  
Environment: LAB AIR; RT

Yield Strength: 113.6 ksi  
Ult. Strength: 120 ksi  
Specimen Thk: 0.746 - 0.752 in.  
Specimen Width: 2.006 - 2.012 in.  
Ref: LG005



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
32.21 (min)	0.212
35.	0.197
40.	0.855
46.00 (max)	10.4

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
24.90 (min)	0.0555
25.	0.0552
30.	0.0672
35.	0.120
40.	0.213
46.12 (max)	0.744

RMS %  
Error  
81.47

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
12.91

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.10.3.1.9

Condition/Ht:  
Form: 3 in. Disk  
Specimen Type: WOL  
Orientation: C-S  
Frequency: 10 Hz  
Environment: LIQUID HYDROGEN; -423°F

Yield Strength: 200 ksi  
Ult. Strength: 211.1 ksi  
Specimen Thk: 0.745 - 0.747 in.  
Specimen Width: 2.006 - 2.012 in.  
Ref: LG005

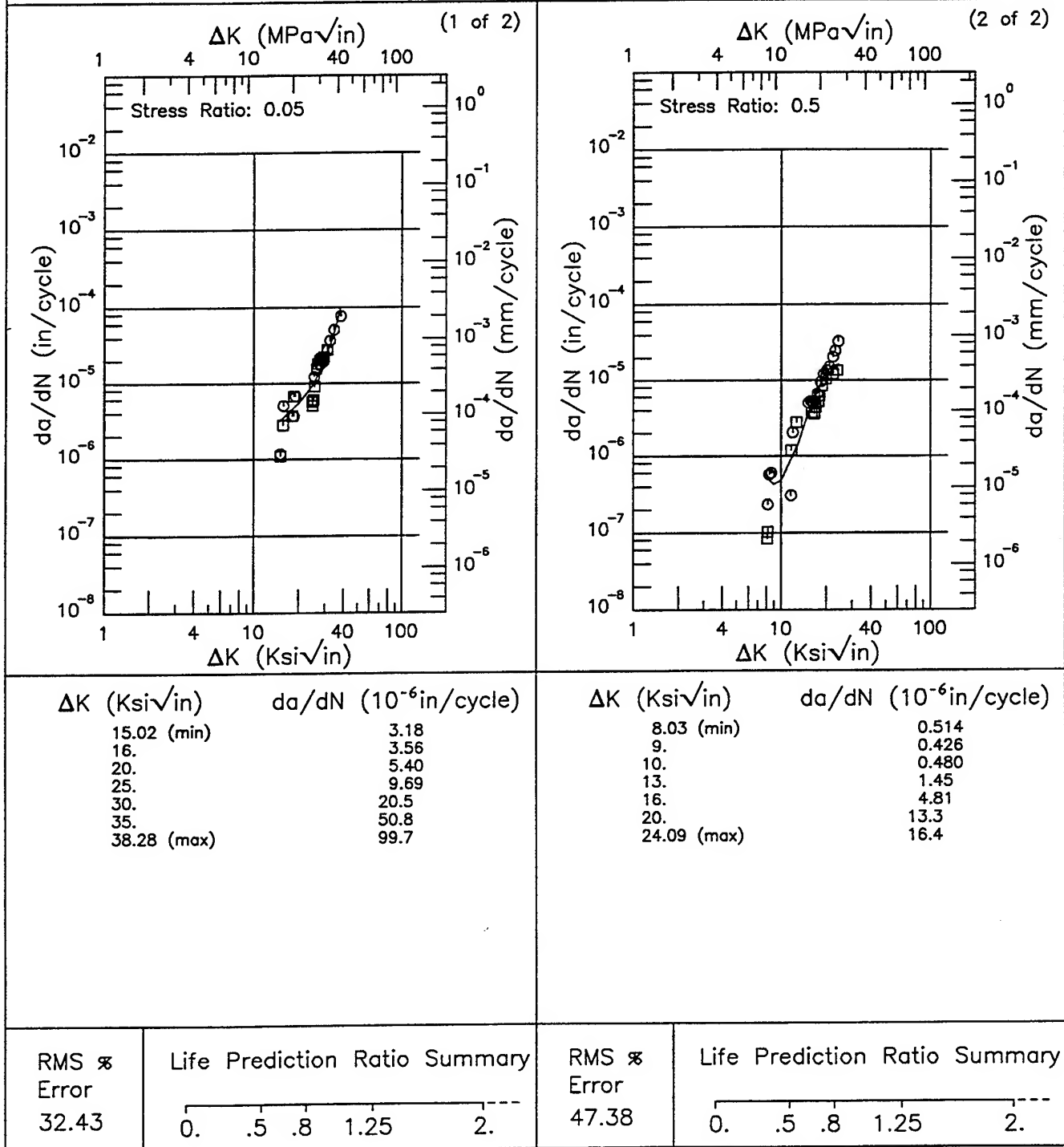
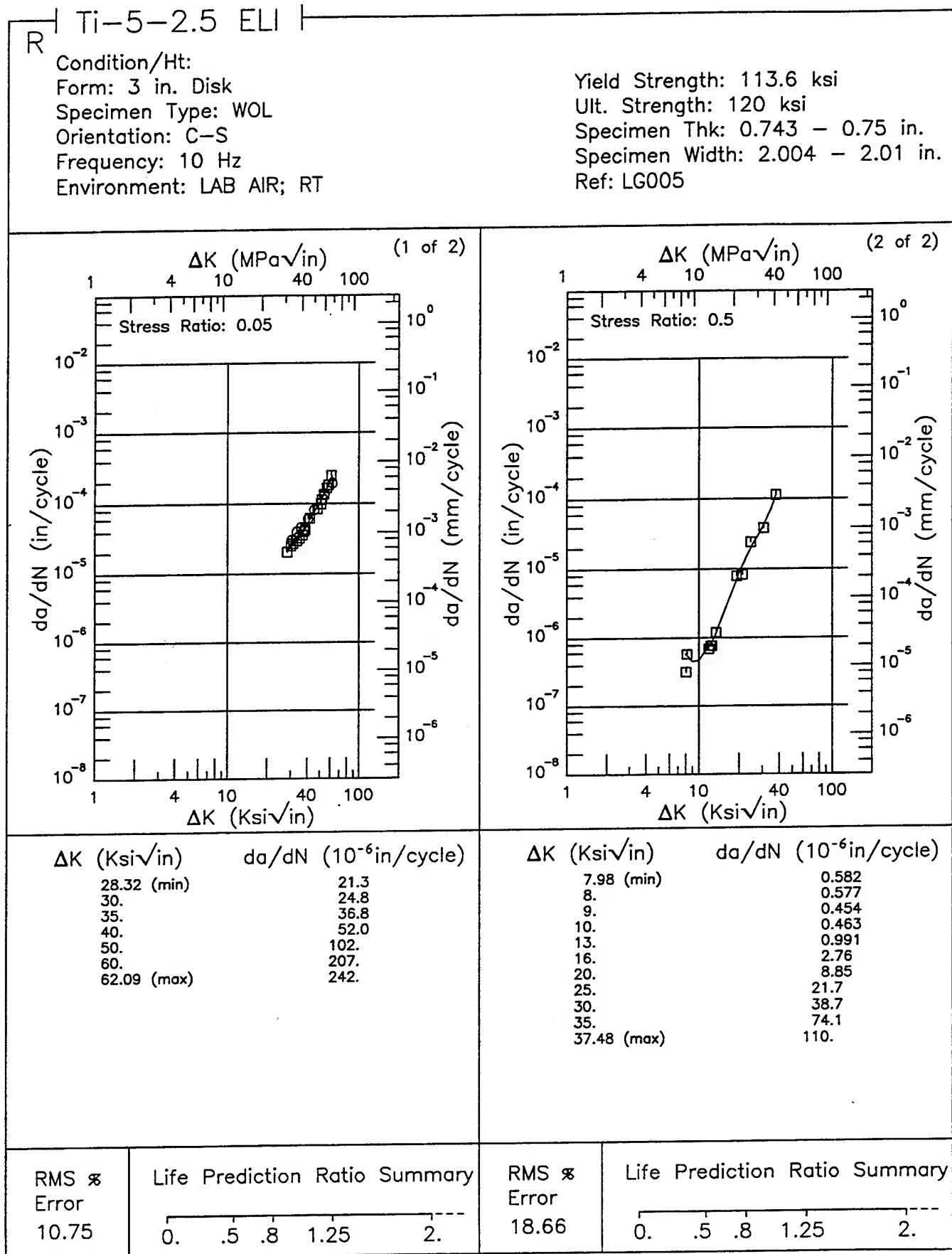


Figure 6.10.3.1.10



**Figure 6.10.3.1.11**

Condition/Ht:  
Form: 3 in. Disk  
Specimen Type: WOL  
Orientation: C-S  
Frequency: 0.1 Hz  
Environment: LAB AIR; RT

Yield Strength: 113.6 ksi  
Ult. Strength: 120 ksi  
Specimen Thk: 0.749 in.  
Specimen Width: 2.01 in.  
Ref: LG005

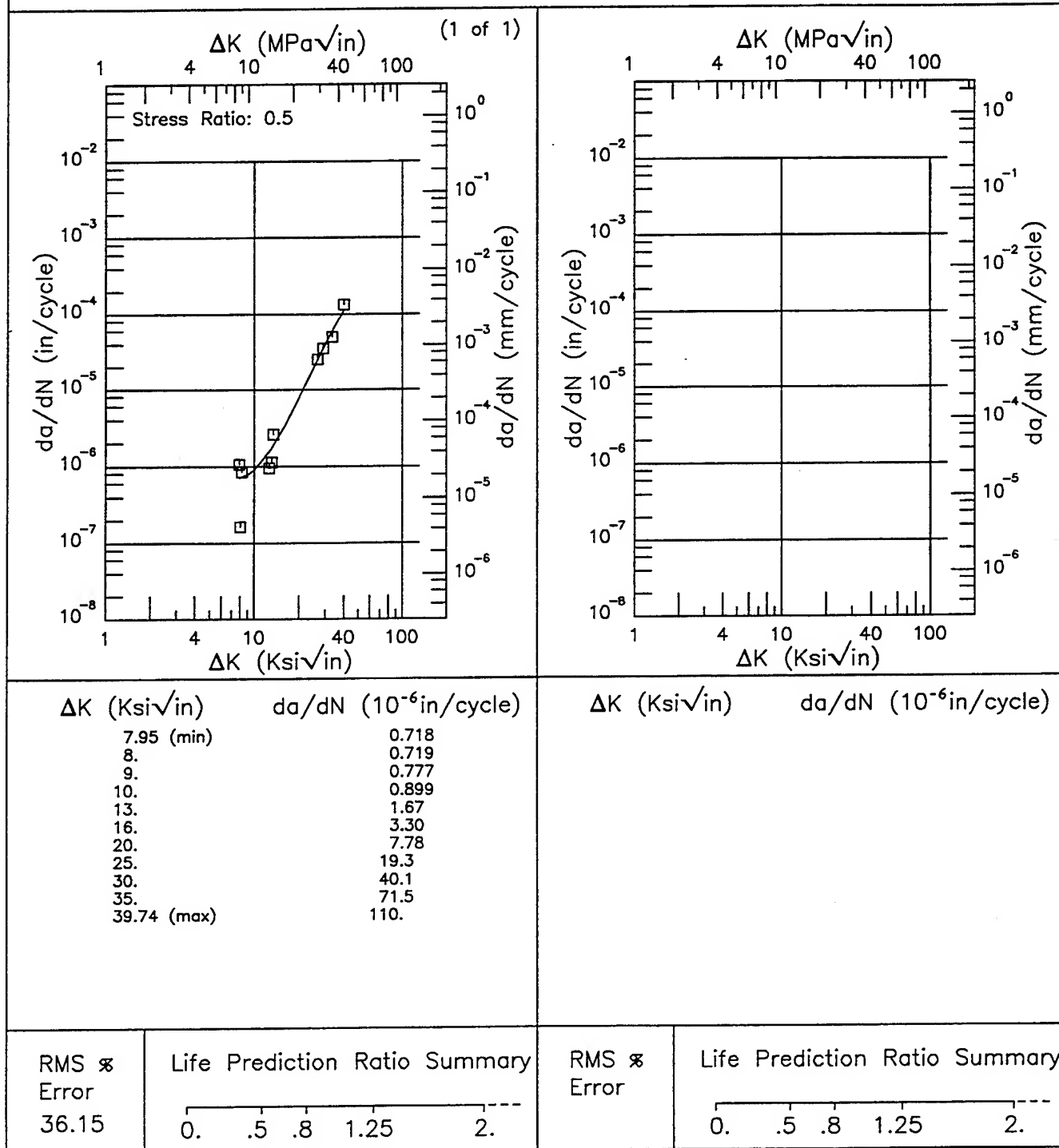


Figure 6.10.3.1.12

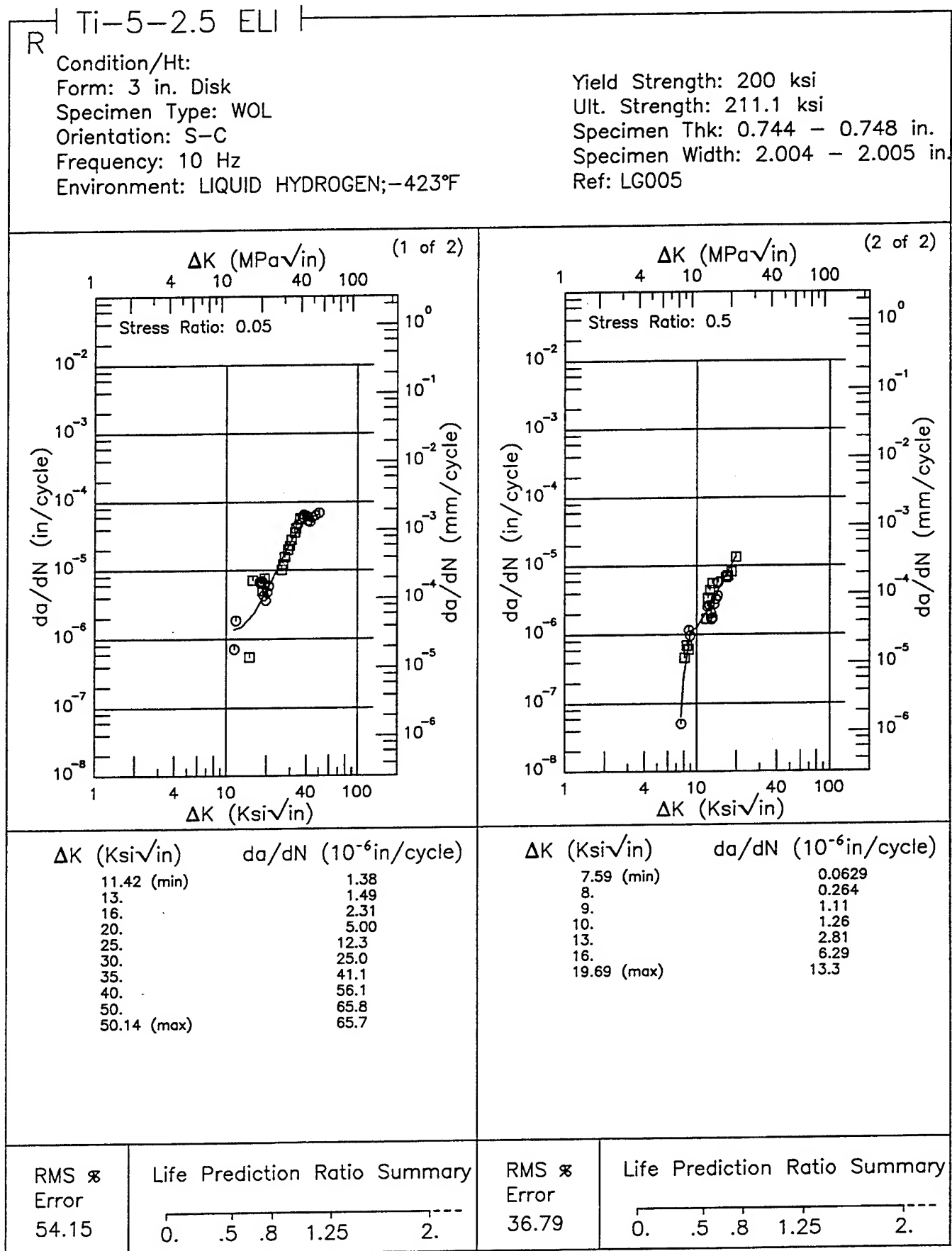


Figure 6.10.3.1.13

Condition/Ht:  
 Form: 3 in. Disk  
 Specimen Type: WOL  
 Orientation: S-C  
 Frequency: 0.1 Hz  
 Environment: LAB AIR; RT

Yield Strength: 113.6 ksi  
 Ult. Strength: 120 ksi  
 Specimen Thk: 0.743 - 0.748 in.  
 Specimen Width: 2.005 - 2.01 in.  
 Ref: LG005

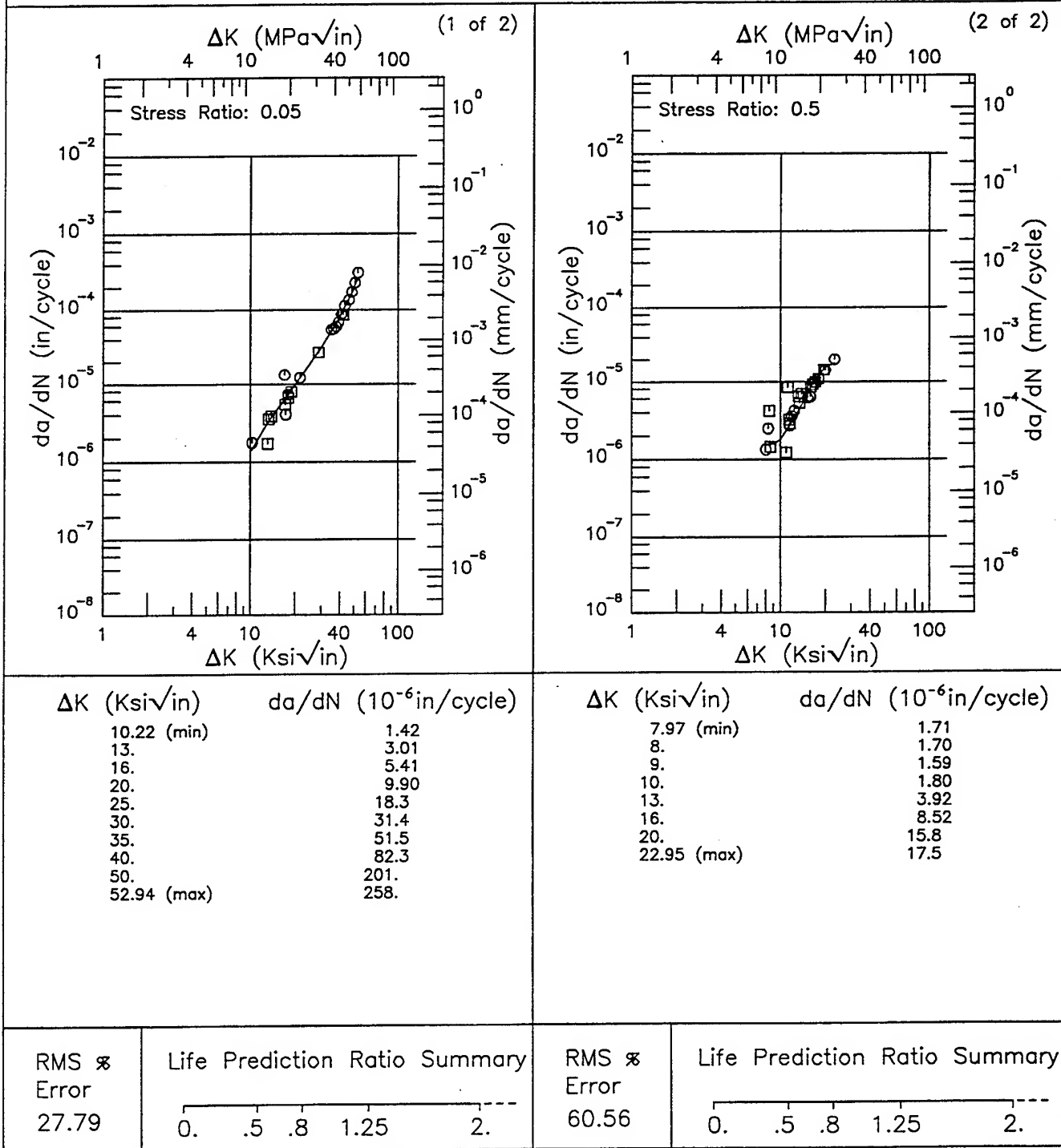
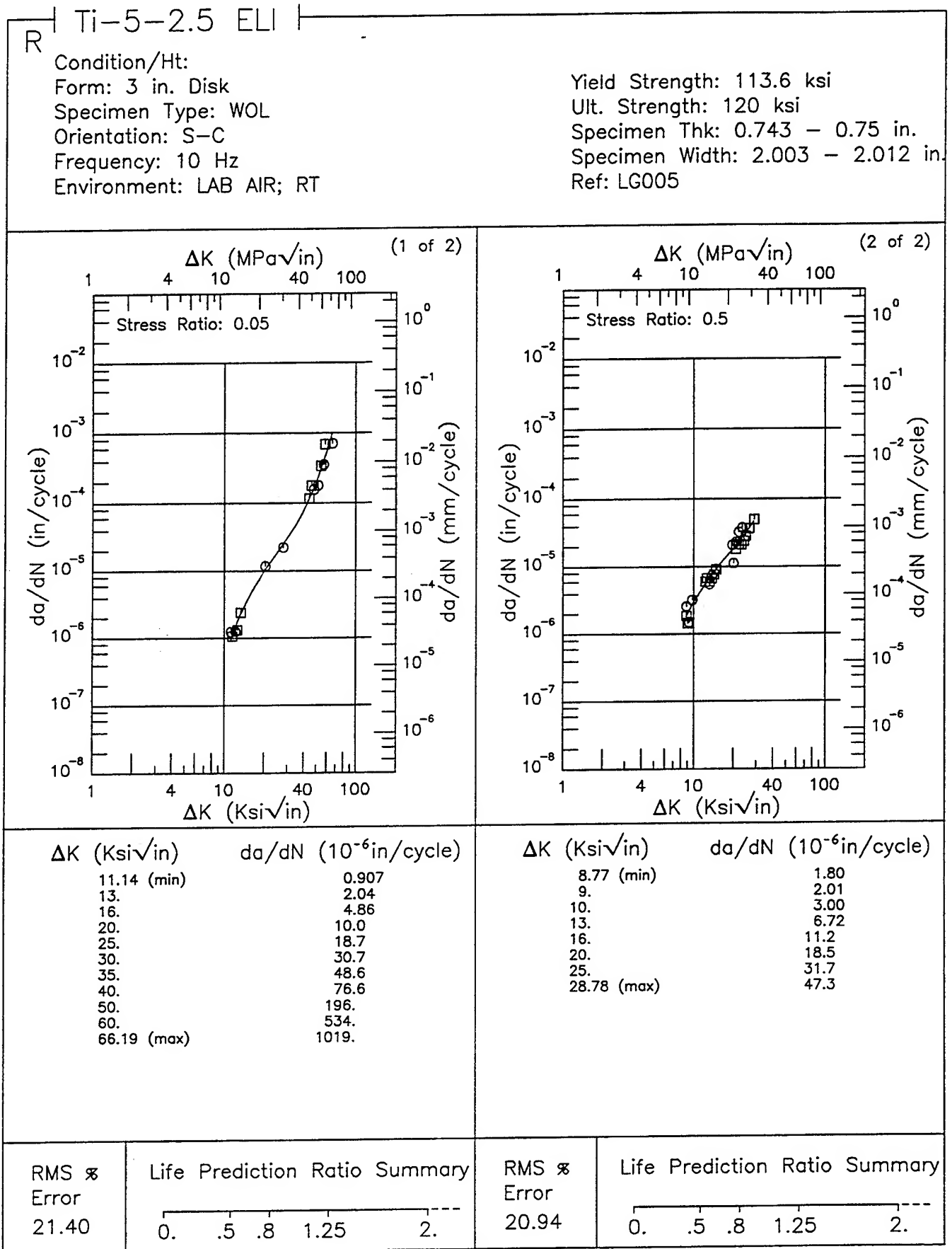


Figure 6.10.3.1.14



**Figure 6.10.3.1.15**

Condition/Ht:

Form: 3 in. Disk

Specimen Type: WOL

Orientation: R-S

Frequency: 10 Hz

Environment: LIQUID HYDROGEN; -423°F

Yield Strength: 200 ksi

Ult. Strength: 211.1 ksi

Specimen Thk: 0.745 - 0.749 in.

Specimen Width: 1.997 - 2.004 in.

Ref: LG005

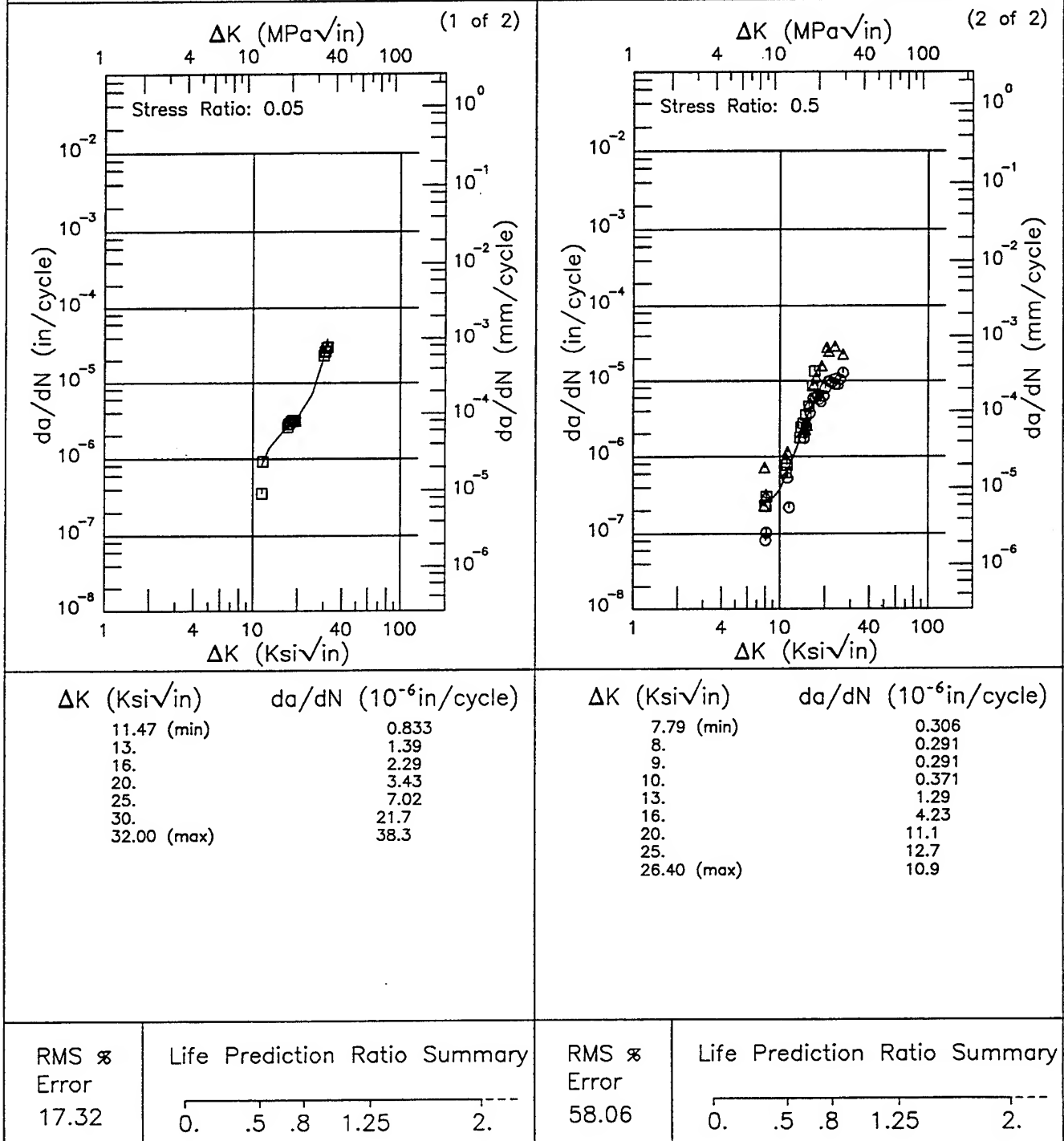


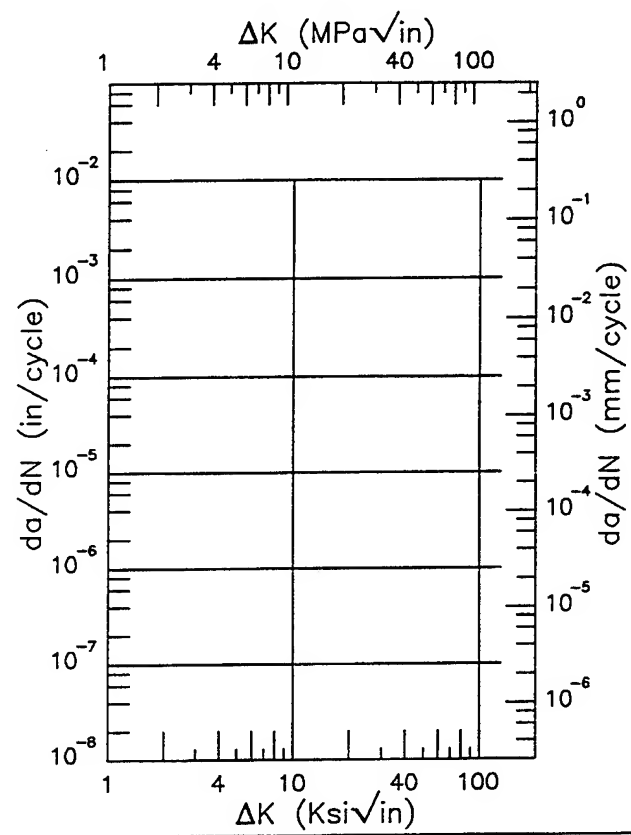
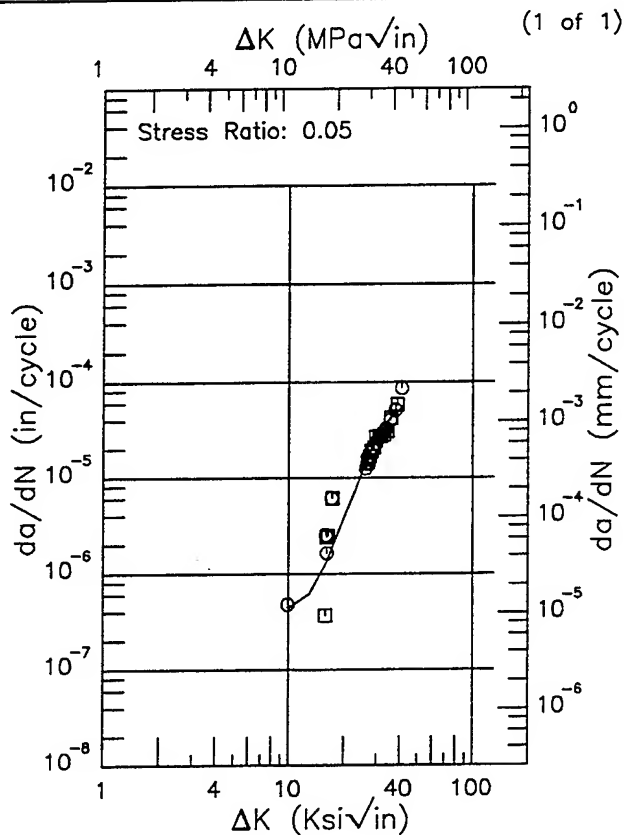
Figure 6.10.3.1.16



R Ti-5-2.5 ELI

Condition/Ht:  
Form: 3 in. Disk  
Specimen Type: WOL  
Orientation: R-S  
Frequency: 0.1 Hz  
Environment: LAB AIR; RT

Yield Strength: 113.6 ksi  
Ult. Strength: 120 ksi  
Specimen Thk: 0.747 in.  
Specimen Width: 2.001 - 2.002 in.  
Ref: LG005



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
9.84 (min)	0.447
10.	0.442
13.	0.616
16.	1.30
20.	3.78
25.	11.5
30.	25.4
35.	41.4
40.	52.1
40.84 (max)	53.0

ΔK (Ksi√in) da/dN (10<sup>-6</sup>in/cycle)

RMS %  
Error  
65.02

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.10.3.1.17

Condition/Ht:  
Form: 3 in. Disk  
Specimen Type: WOL  
Orientation: R-S  
Frequency: 10 Hz  
Environment: LAB AIR; RT

Yield Strength: 113.6 ksi  
Ult. Strength: 120 ksi  
Specimen Thk: 0.744 - 0.748 in.  
Specimen Width: 1.996 - 2.002 in.  
Ref: LG005

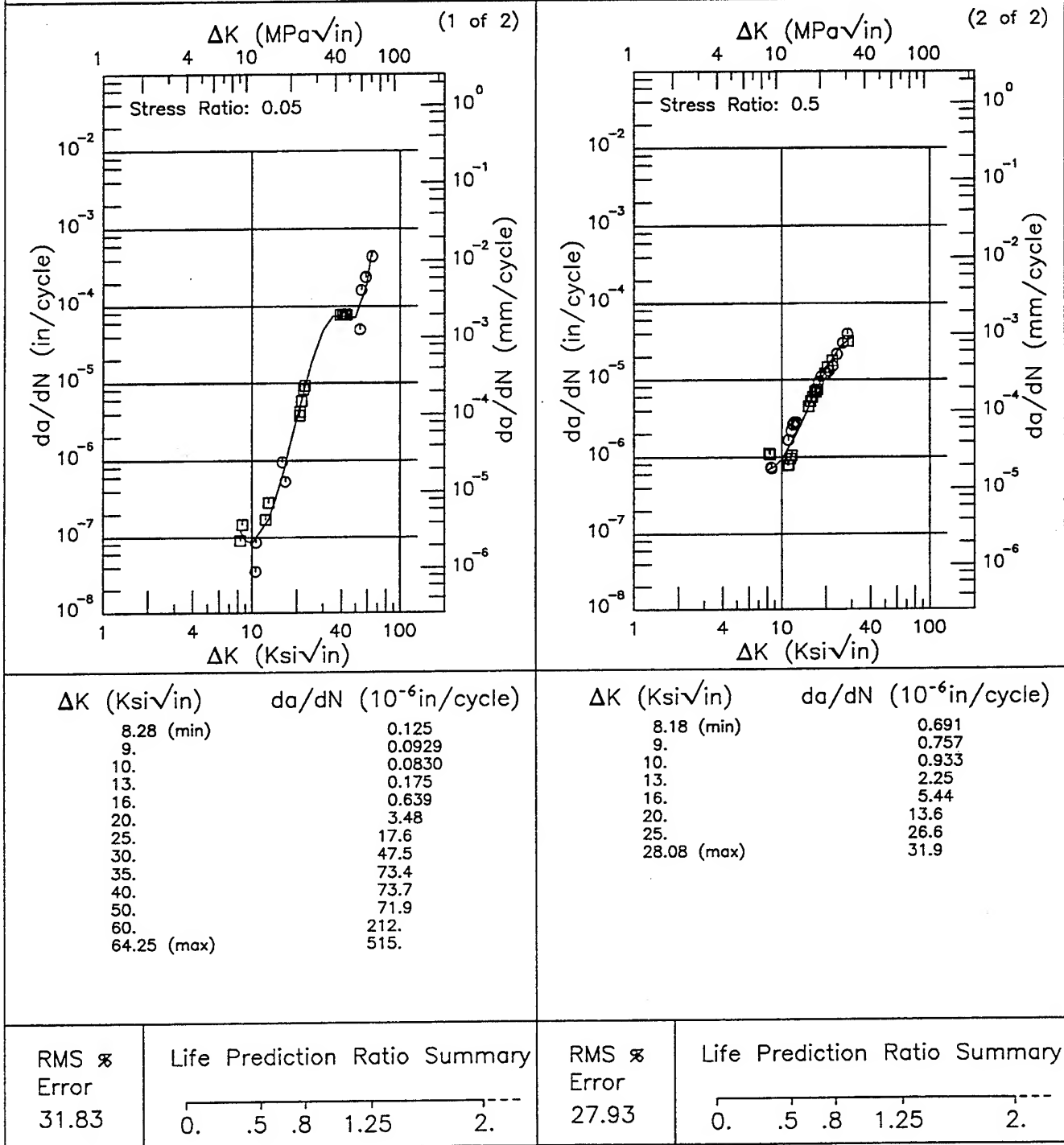


Figure 6.10.3.1.18

R | Ti-5-2.5 ELI |

Condition/Ht:

Form: 3 in. Disk

Specimen Type: WOL

Orientation: S-R

Frequency: 0.1 Hz

Environment: LIQUID HYDROGEN; -423°F

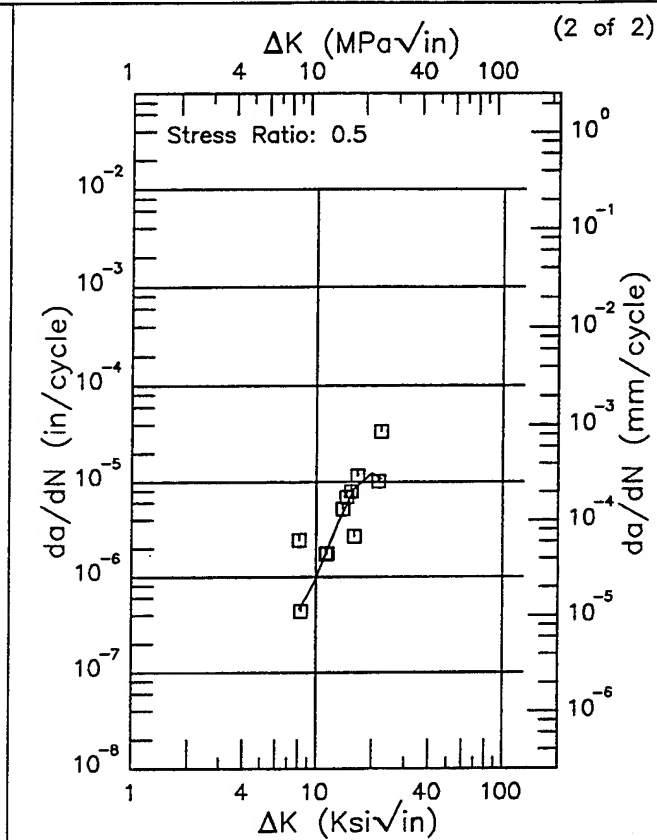
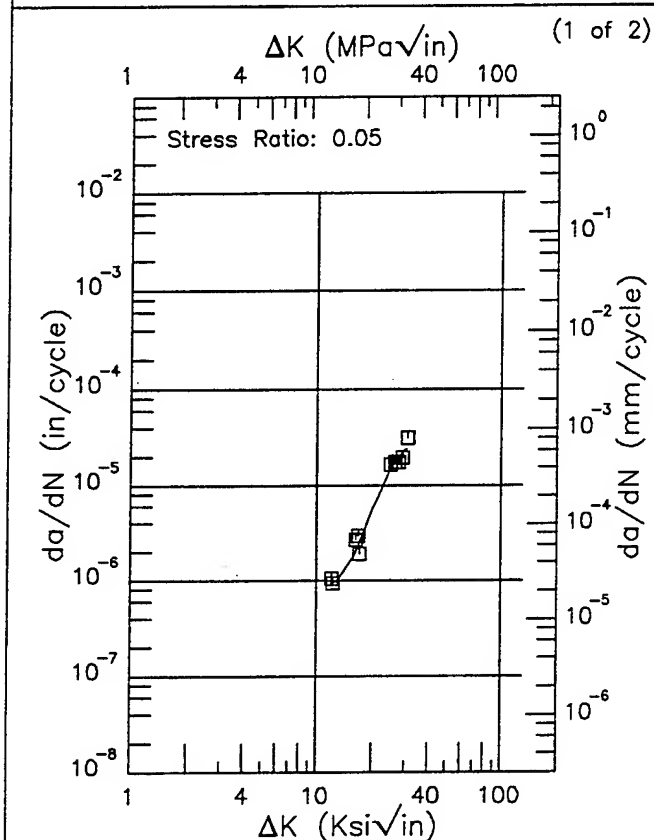
Yield Strength: 200 ksi

Ult. Strength: 211.1 ksi

Specimen Thk: 0.746 in.

Specimen Width: 2.003 - 2.006 in.

Ref: LG005



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
12.00 (min)	0.942
13.	1.00
16.	1.89
20.	5.56
25.	15.4
30.	24.1
30.73 (max)	24.5

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
8.09 (min)	0.466
9.	0.639
10.	0.981
13.	3.53
16.	8.46
20.	12.4
22.27 (max)	10.8

RMS %  
Error  
18.91

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
Error  
>100.0

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 6.10.3.1.19

Condition/Ht:  
Form: 3 in. Disk  
Specimen Type: WOL  
Orientation: S-R  
Frequency: 10 Hz  
Environment: LIQUID HYDROGEN; -423°F

Yield Strength: 200 ksi  
Ult. Strength: 211.1 ksi  
Specimen Thk: 0.744 - 0.748 in.  
Specimen Width: 2.004 - 2.011 in.  
Ref: LG005

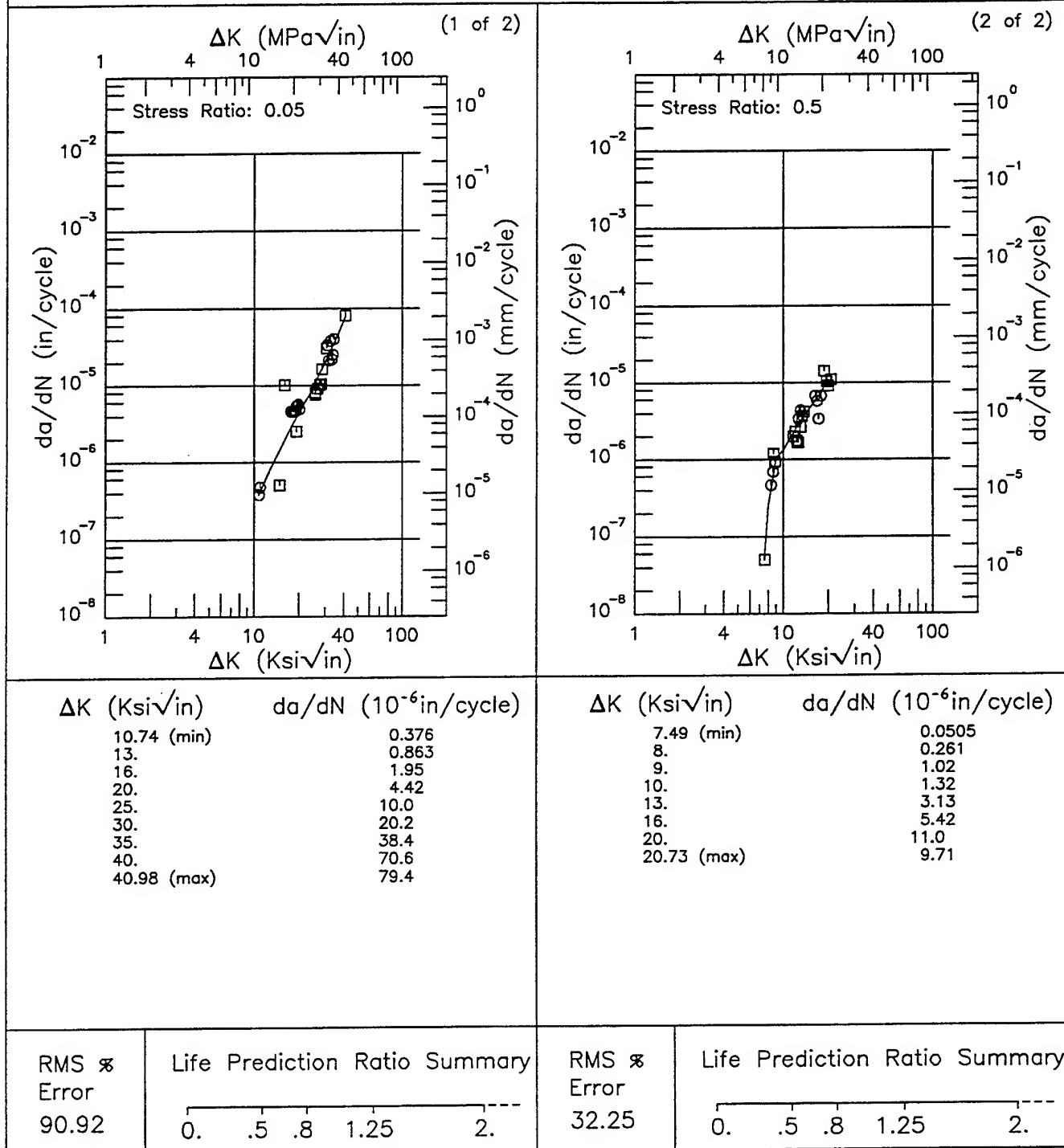


Figure 6.10.3.1.20

R

Ti-5-2.5 ELI

Condition/Ht:

Form: 3 in. Disk

Specimen Type: WOL

Orientation: S-R

Frequency: 0.1 Hz

Environment: LAB AIR; RT

Yield Strength: 113.6 ksi

Ult. Strength: 120 ksi

Specimen Thk: 0.746 - 0.749 in.

Specimen Width: 2.004 - 2.009 in.

Ref: LG005

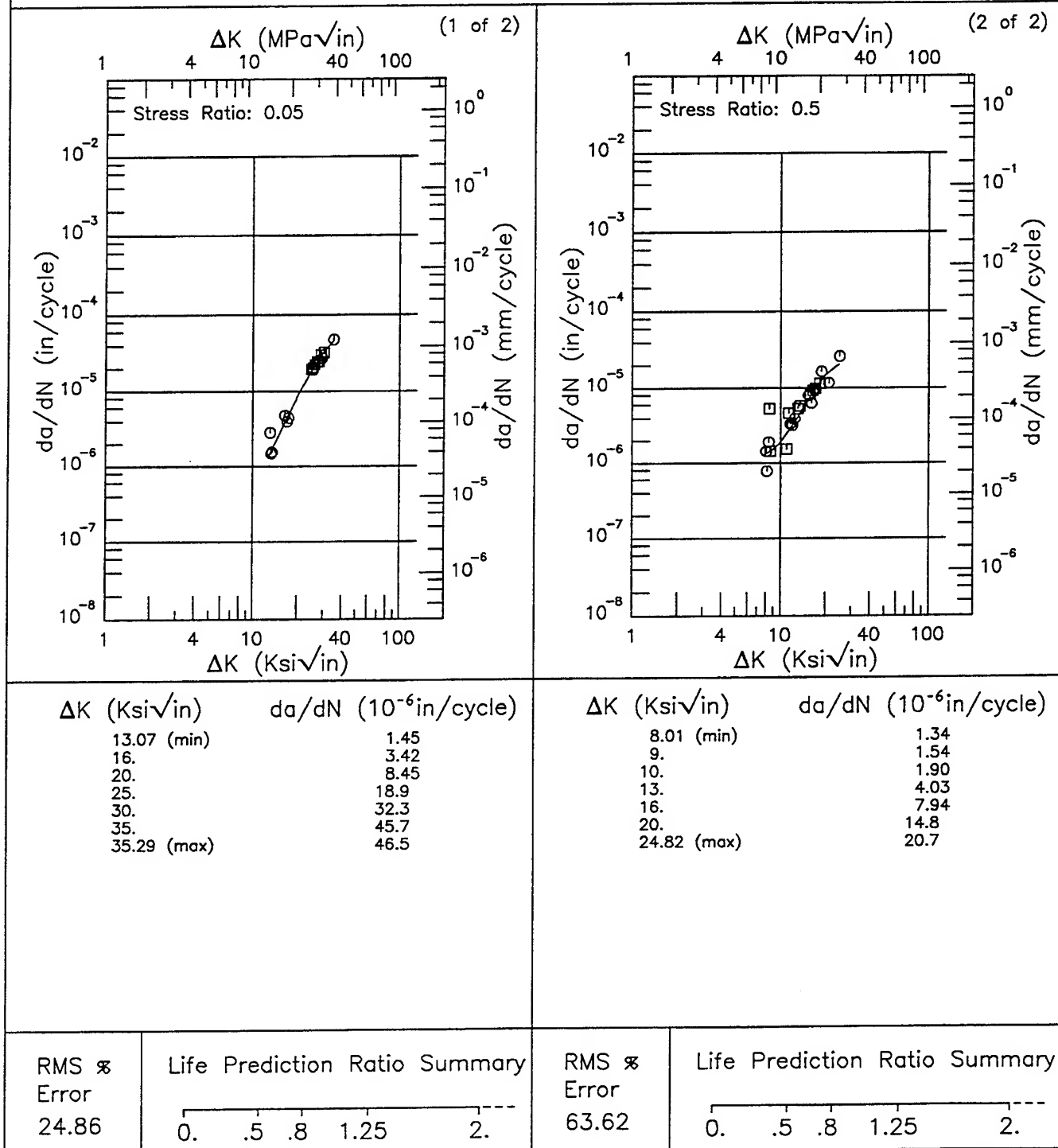


Figure 6.10.3.1.21

Condition/Ht:  
Form: 3 in. Disk  
Specimen Type: WOL  
Orientation: S-R  
Frequency: 10 Hz  
Environment: LAB AIR; RT

Yield Strength: 113.6 ksi  
Ult. Strength: 120 ksi  
Specimen Thk: 0.745 - 0.747 in.  
Specimen Width: 2.004 - 2.01 in.  
Ref: LG005

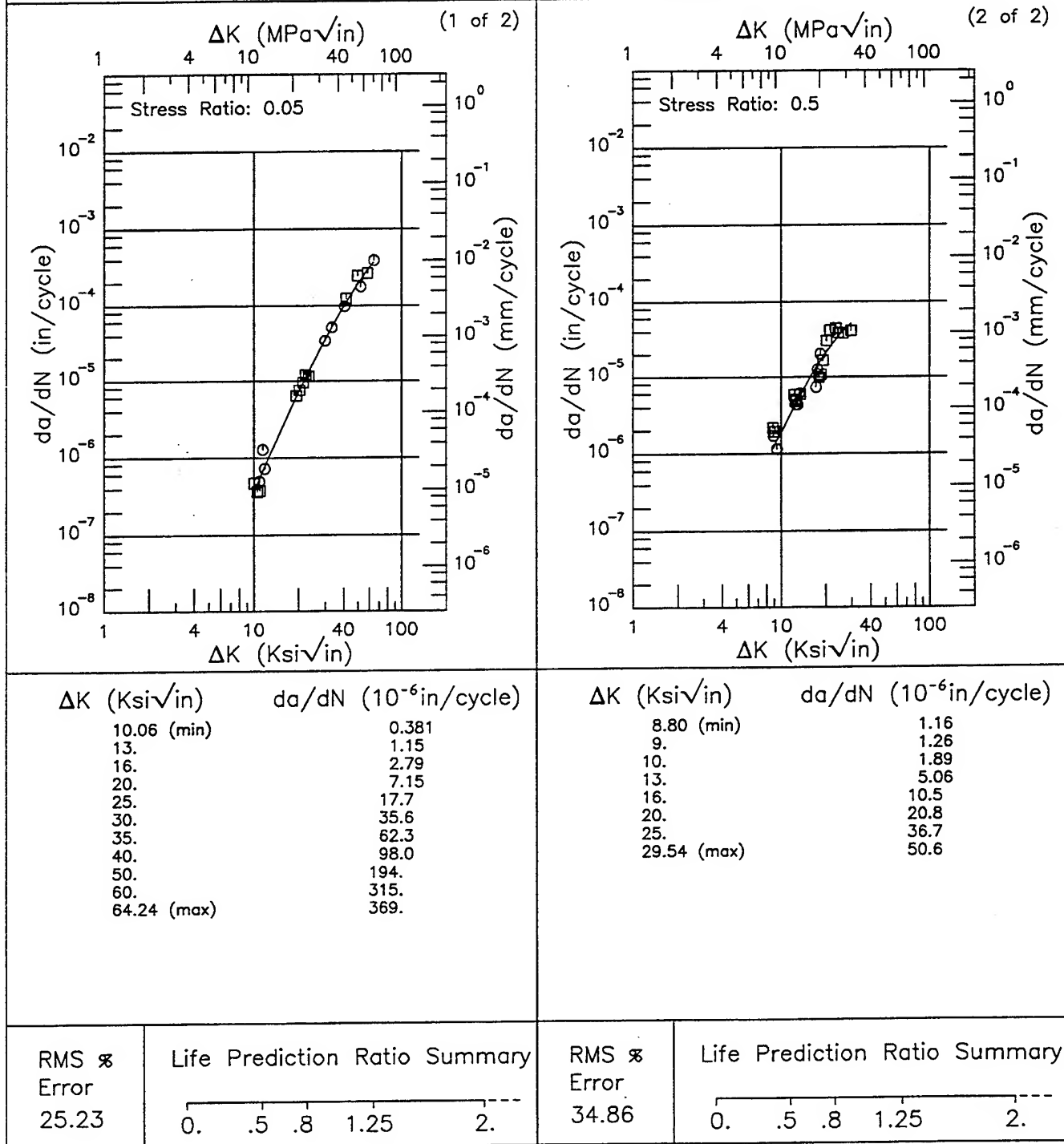


Figure 6.10.3.1.22

TABLE 6.11.1.2.1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-5Al-2.5Sn AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: 3.5% NaCl

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $K_{SI}/\sqrt{in}$ )					
				2.6	6.0	10.0	20.0	60.0	100.0
ANNEALED	SHEET	0.1	50				23.6		
		0.1-0.67	30-55			8.79	28.64	160.44	
		0.67	55		0.29	7.38			

TABLE 6.11.1.2.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-5Al-2.5Sn AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Distilled Water

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED	SHEET	0.1	30					124.12	
		0.1	50				11.77		
		0.07	55		0.25	3.38			



TABLE 6.11.1.2.3

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-5Al-2.5Sn AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Dry Argon

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $K_{SI}/\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED	SHEET	0.1	30				5.68	94.72	
		0.1	60				4.77		
		0.67	55-58.3		0.03	0.27			

TABLE 6.11.1.2.4

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-5Al-2.5Sn AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K_{Leel}$ (Ksi $\sqrt{in}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
ANNEALED	SHEET	0.1	30				11.58	123.8	
		0.1	50				11.69		
		0.67	55		0.15	2.17			

TABLE 6.11.1.2.5

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-5Al-2.5Sn AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: 3.5% NaCl

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED	SHEET	0.1	30					177.01	
		0.1	50				24.35		
		0.67	54,2-55		0.7	12.52			

1 of 1

TABLE 6.11.1.2.6

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-5Al-2.5Sn AT ROOM TEMPERATURE**

**ORIENTATION: T-L**                      **ENVIRONMENT: Distilled Water**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED	SHEET	0.1	30				12.51	130.45	
		0.1	50				11.97		
		0.07	55		0.36	3.74			

TABLE 6.11.1.2.7

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-5Al-2.5Sn AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: Dry Argon

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED	SHEET	0.1	30				5.38	114.1	
		0.1	50-53.3				5.37		
		0.67	55			0.49			

**TABLE 6.11.1.2.8**

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
Ti-5Al-2.5Sn AT ROOM TEMPERATURE**

## ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $K_{SI}/\sqrt{in}$ )					
				2.5	6.0	10.0	20.0	60.0	100.0
ANNEALED	SHEET	0.1	30				11.18	140.04	
		0.1	50				11.76		
		0.67	55-58.3		0.16	3.08			

TABLE 6.11.2.2

TI-5AL-2.5SN K <sub>C</sub>																				
CONDITION HEAT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>				K <sub>C</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>o</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi/in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi/in.)	K <sub>C</sub> MEAN	STAN DEV			
BUCKLING OF CRACK EDGES RESTRAINED																				
ANNEALED	Sheet	0.06	-423	L-T	228.0	1.000	0.062	0.080	---	---	131.10	46.66	55.1	6.0	---	---	---	1971	80104	
		0.06			228.0	1.000	0.063	0.410	---	---	63.90	57.34			---			---	1971	80104
		0.06			228.0	1.000	0.064	0.480	---	---	54.60	55.53			---			---	1971	80104
		0.06			228.0	1.000	0.064	0.170	---	---	115.50	60.77			---			---	1971	80104
ANNEALED	Sheet	0.10	-423	L-T	211.0	1.000	0.111	0.120	---	---	161.30	70.66*	74.2	0.4	---	---	---	1971	80104	
		0.10			211.0	1.000	0.113	0.360	---	---	90.30	73.90			---			---	1971	80104
		0.10			211.0	1.000	0.113	0.240	---	---	116.90	74.44			---			---	1971	80104
		0.06			228.0	2.000	0.062	0.080	---	---	147.10	52.20			---			---	1971	80104
ANNEALED	Sheet	0.06	-423	L-T	228.0	2.000	0.063	0.140	---	---	123.00	57.86	59.0	4.9	---	---	---	1971	80104	
		0.06			228.0	2.000	0.063	0.790	---	---	46.80	57.80			---			---	1971	80104
		0.06			228.0	2.000	0.063	0.180	---	---	115.10	61.51			---			---	1971	80104
		0.06			228.0	2.000	0.064	0.420	---	---	78.30	65.39			---			---	1971	80104
ANNEALED	Sheet	0.10	-423	L-T	211.0	2.000	0.112	0.130	---	---	158.30	71.72*	77.6	1.1	---	---	---	1971	80104	
		0.10			211.0	2.000	0.113	0.380	---	---	97.30	76.89			---			---	1971	80104
		0.10			211.0	2.000	0.114	0.270	---	---	119.00	78.38			---			---	1971	80104
		0.02			203.5	3.000	0.018	0.500	---	---	110.10	99.28			---			---	1967	68968
ANNEALED	Sheet	0.02	-423	L-T	203.5	3.000	0.019	0.540	0.810	---	103.60	97.37	95.4	2.8	122.41	115.6	4.9	1967	68968	
		0.02			203.5	3.000	0.019	1.040	1.300	---	69.00	95.36			111.85			1967	68968	
		0.02			203.5	3.000	0.019	0.150	0.270	---	165.40	80.41*			108.26*			1967	68968	
		0.02			203.5	3.000	0.019	0.150	0.270	---	165.40	80.41*			108.26*			1967	68968	

\* NOTE: NET SECTION STRESS EXCEEDS 90% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.



TABLE 6.11.2.2 (CONTINUED)

TI-5AL-2.5SN K <sub>C</sub>																			
CONDITION HEAT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>			K <sub>C</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>y</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi√in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi√in.)	K <sub>C</sub> MEAN	STAN DEV		
BUCKLING OF CRACK EDGES RESTRAINED																			
ANNEALED Cont'd	Sheet Cont'd	0.02	-423 Cont'd	L-T Cont'd	203.5	3.000	0.019	1.000	---	---	69.30	93.33	Cont'd	Cont'd	Cont'd	---	Cont'd	1967	68968
		0.02			203.5	3.000	0.019	1.020	1.240	---	72.20	98.51				112.90		68968	
		0.02			203.5	3.000	0.019	0.320	0.500	---	129.90	92.75				117.13		68968	
		0.02			203.5	3.000	0.019	0.340	0.670	---	127.90	94.22				135.40*		68968	
		0.02			203.5	3.000	0.019	0.120	0.300	---	181.00	78.68*				125.02*		68968	
		0.02			203.5	3.000	0.019	0.510	0.730	---	107.60	98.06				119.62		68968	
		0.02			203.5	3.000	0.020	0.150	0.330	---	172.70	83.96*				125.28*		68968	
		0.02			203.5	3.000	0.020	0.270	0.470	---	138.90	90.91				121.19*		68968	
		0.02			203.5	3.000	0.020	1.030	1.280	---	68.60	94.20				109.88		68968	
		0.06			228.0	3.000	0.064	0.990	---	---	49.50	64.89				---		---	---
ANNEALED	Sheet	0.10	-423	L-T	211.0	3.000	0.116	1.060	---	---	55.20	76.77	77.4	0.9	---	---	1971	80104	
		0.10			211.0	3.000	0.116	0.990	---	---	58.30	78.01				---	1971	80104	
		0.02			203.5	6.000	0.017	2.000	2.390	---	50.10	95.42				107.82	1967	68968	
ANNEALED	Sheet	0.02	-423	L-T	203.5	6.000	0.018	2.010	2.220	---	49.00	93.63	94.8	1.8	109.4	100.40	1967	68968	
		0.02			203.5	6.000	0.018	0.130	0.260	---	181.60	82.09*				113.92*	68968		
		0.02			203.5	6.000	0.018	0.130	0.220	---	191.90	86.74*				112.90*	68968		
		0.02			203.5	6.000	0.018	0.490	0.800	---	105.90	93.29				120.03	1967	68968	
		0.02			203.5	6.000	0.018	1.000	1.330	---	73.70	93.98				109.87	1967	68968	
		0.02			203.5	6.000	0.018	2.000	2.420	---	48.80	92.95				105.98	1967	68968	
		0.02			203.5	6.000	0.018	2.000	2.420	---	48.80	92.95				105.98	1967	68968	
		0.02			203.5	6.000	0.018	2.000	2.420	---	48.80	92.95				105.98	1967	68968	

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.



TABLE 6.11.2.2 (CONTINUED)

TI-5AL-2.5SN K <sub>C</sub>																			
CONDITION HEAT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>			K <sub>C</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>o</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi√in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi√in.)	K <sub>C</sub> MEAN	STAN DEV		
BUCKLING OF CRACK EDGES RESTRAINED																			
ANNEALED Cont'd	Sheet Cont'd	0.02	-423 Cont'd	L-T Cont'd	203.5	6.000	0.018	0.490	0.640	---	110.50	97.34	Cont'd	Cont'd	111.58	Cont'd	Cont'd	1967	68968
		0.02			203.5	6.000	0.019	0.240	0.640	---	156.40	96.12			157.92*			1967	68968
		0.02			203.5	6.000	0.019	0.500	0.720	---	109.10	97.10			117.07			1967	68968
		0.02			203.5	6.000	0.019	1.000	1.340	---	74.10	94.49			110.94			1967	68968
		0.02			203.5	6.000	0.019	0.250	0.530	---	153.30	96.17			140.55*			1967	68968
		0.02			203.5	6.000	0.019	1.020	1.210	---	71.40	92.02			100.98			1967	68968
		0.02			203.5	6.000	0.019	0.250	0.610	---	157.20	98.62*			154.87*			1967	68968
		0.02			203.5	12.000	0.018	0.240	0.650	---	154.40	94.82			156.30*			1967	68968
		0.02			203.5	12.000	0.018	0.500	0.690	---	103.60	91.91			108.08			1967	68968
		0.02			203.5	12.000	0.018	0.490	0.620	---	104.30	91.60			103.10			1967	68968
ANNEALED	Sheet	0.02	-423	L-T	203.5	12.000	0.018	0.980	1.190	---	76.00	94.68	94.0	3.8	104.54	107.0	9.0	1967	68968
		0.02			203.5	12.000	0.019	4.000	4.450	---	35.40	95.35			102.42			1967	68968
		0.02			203.5	12.000	0.019	0.130	0.380	---	178.40	80.62*			137.92*			1967	68968
		0.02			203.5	12.000	0.019	0.490	0.660	---	108.60	95.38			110.78			1967	68968
		0.02			203.5	12.000	0.019	2.000	2.410	---	52.10	93.96			103.97			1967	68968
		0.02			203.5	12.000	0.019	1.000	1.170	---	71.30	89.75			97.23			1967	68968
		0.02			203.5	12.000	0.019	2.000	2.460	---	51.20	92.34			103.34			1967	68968
		0.02			203.5	12.000	0.020	4.000	4.040	---	39.20	105.59			106.28			1967	68968
		0.02			203.5	12.000	0.020	0.120	0.260	---	183.90	79.85*			117.56*			1967	68968
		0.02			203.5	12.000	0.020	0.120	0.260	---	183.90	79.85*			117.56*			1967	68968

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.

TABLE 6.11.2.2 (CONCLUDED)

TI-5AL-2.5SN K <sub>C</sub>																			
CONDITION HEAT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>			K <sub>C</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>o</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi√in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi√in.)	K <sub>C</sub> MEAN	STAN DEV		
BUCKLING OF CRACK EDGES RESTRAINED																			
ANNEALED Cont'd	Sheet Cont'd	0.02	-423 Cont'd	L-T Cont'd	203.5	12.000	0.020	4.020	4.350	---	35.20	95.12	Cont'd	Cont'd	100.26	Cont'd	Cont'd	1967	68968
		0.02			203.5	12.000	0.020	0.240	0.470	---	153.20	94.09			131.76				
		0.02			203.5	12.000	0.020	0.120	0.310	---	181.10	78.63*			126.43*				
		0.02			203.5	12.000	0.021	0.240	0.400	---	151.30	92.92			120.01				
		0.02			203.5	12.000	0.021	0.990	1.370	---	70.90	88.79			104.85				
		0.02			203.5	12.000	0.021	2.000	2.330	---	51.60	93.06			101.08				
ANNEALED	Sheet	0.02	-423	L-T	193.3	15.930	0.016	4.980	5.480	---	32.80	97.69	92.3	7.6	103.92	97.1	9.6	1967	68968
		0.02			193.3	15.930	0.019	4.980	5.280	---	29.20	86.97			90.29				
ANNEALED	Sheet	0.06	-420	L-T	228.0	3.000	0.064	1.000	---	---	44.90	60.47	---	---	---	---	---	1971	80104
ANNEALED	Sheet	0.02	-320	L-T	171.2	15.940	0.018	5.000	5.400	---	44.60	133.16	---	---	139.93	---	---	1967	68968
ANNEALED	Sheet	0.02	-320	L-T	171.2	16.230	0.020	4.980	5.610	---	44.80	133.11	---	---	143.73	---	---	1967	68968
ANNEALED	Sheet	0.20	R.T.	L-T	110.7	13.880	0.202	4.550	---	---	68.70	196.87*	---	---	---	---	---	1966	66218
ANNEALED	Sheet	0.02	R.T.	L-T	109.3	15.950	0.018	5.060	6.780	---	54.50	163.94	---	---	200.71*	---	---	1967	68968
ANNEALED	Sheet	0.02	R.T.	L-T	109.3	16.390	0.018	5.070	6.660	---	58.70	176.16	---	---	211.86*	---	---	1967	68968
ANNEALED	Sheet	0.02	-423	T-L	211.8	12.000	0.015	1.130	1.390	---	64.70	86.67	83.8	4.0	96.40	107.7	16.0	1966	66103
		0.02			211.8	12.000	0.015	0.330	0.710	---	112.40	80.96			118.96				
ANNEALED	Sheet	0.03	-423	T-L	207.3	12.000	0.036	0.280	1.070	---	129.00	85.58	93.7	11.5	168.07	147.6	28.9	1966	66103
		0.03			207.3	12.000	0.036	1.200	1.840	---	73.70	101.81			127.14				

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.

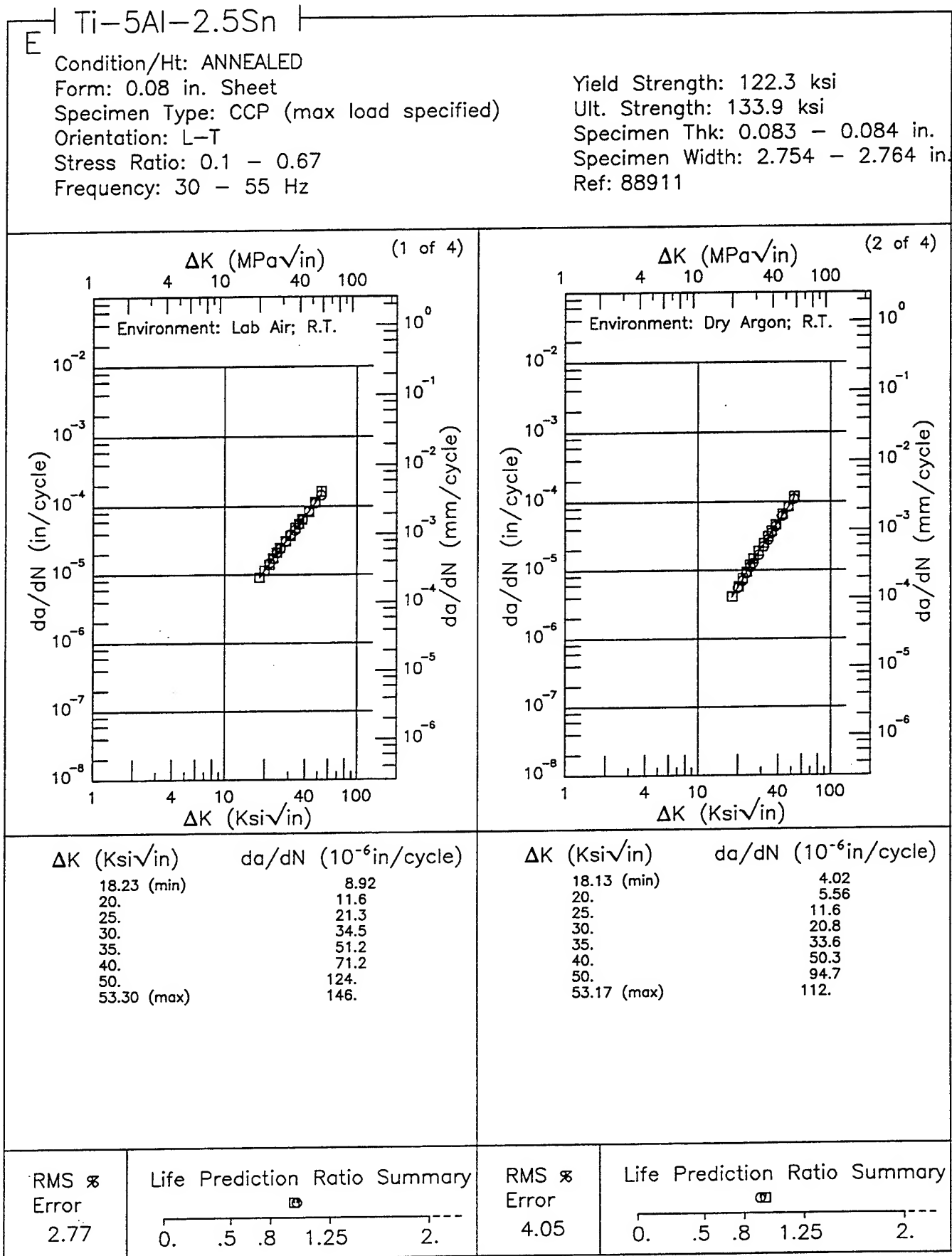


Figure 6.11.3.1.1

Condition/Ht: ANNEALED

Form: 0.08 in. Sheet

Specimen Type: CCP (max load specified)

Orientation: L-T

Stress Ratio: 0.1

Frequency: 30 Hz

Yield Strength: 122.3 ksi

Ult. Strength: 133.9 ksi

Specimen Thk: 0.083 - 0.084 in.

Specimen Width: 2.754 - 2.764 in.

Ref: 88911

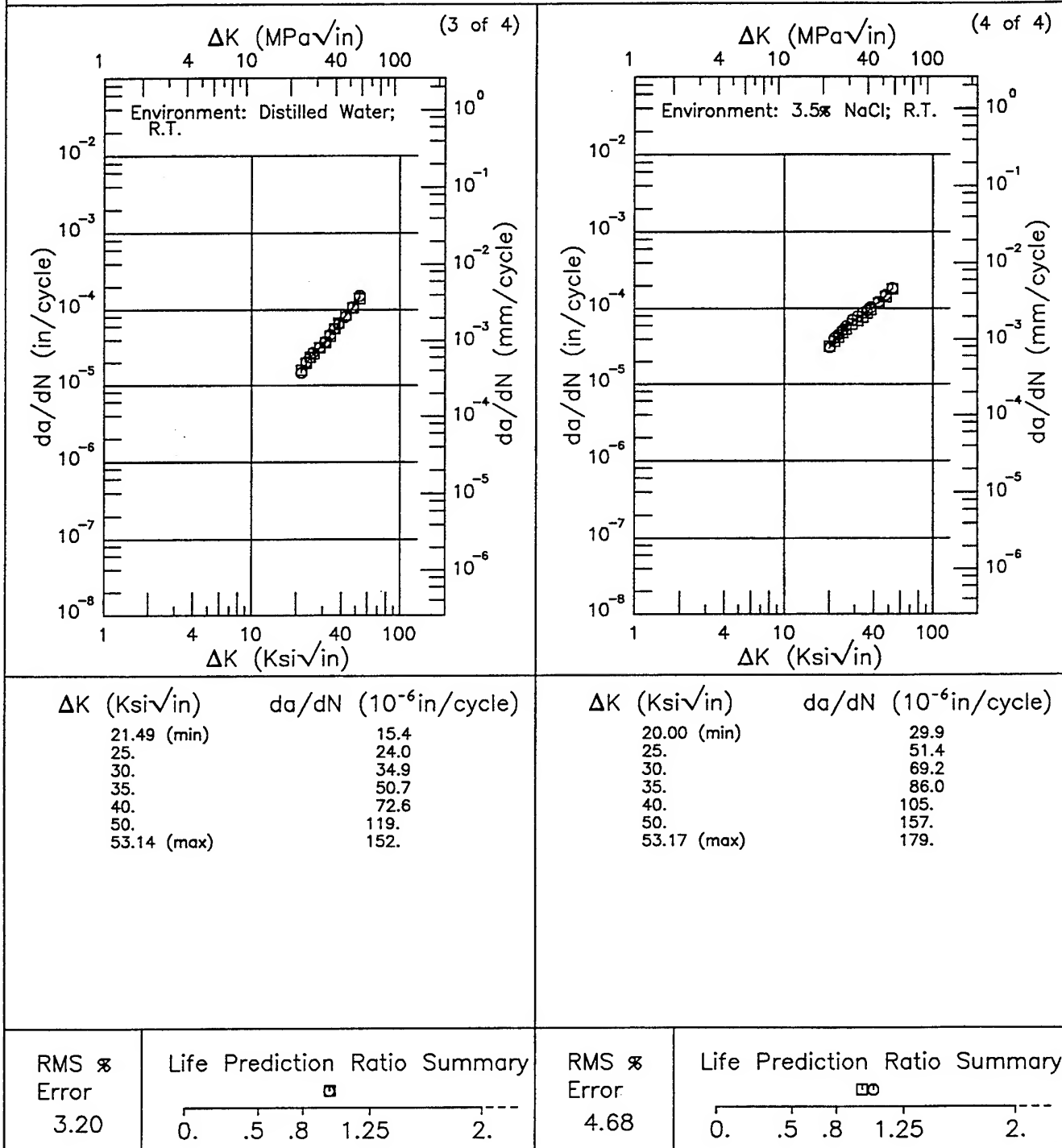


Figure 6.11.3.1.1 (Concluded)

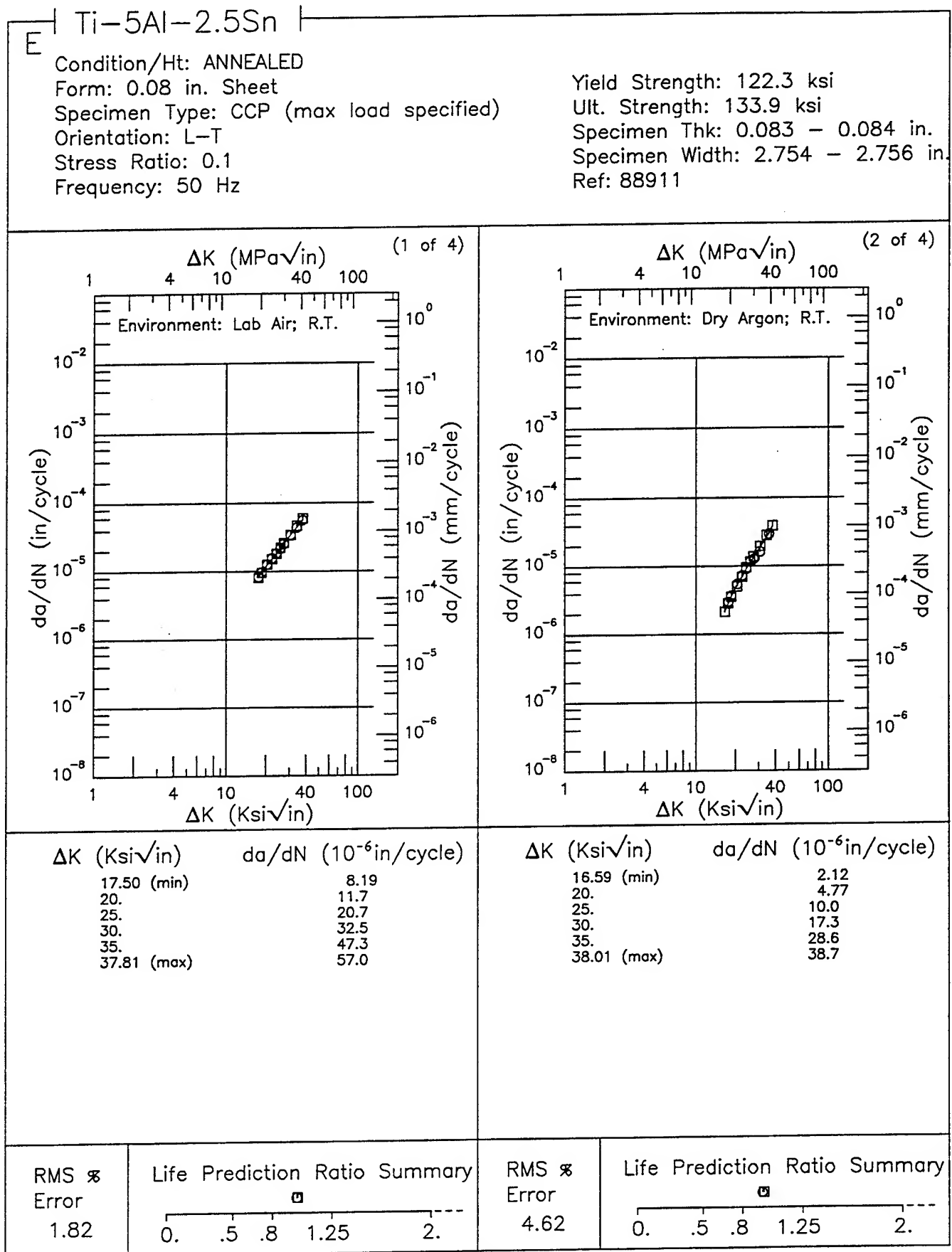


Figure 6.11.3.1.2

Condition/Ht: ANNEALED

Form: 0.08 in. Sheet

Specimen Type: CCP (max load specified)

Orientation: L-T

Stress Ratio: 0.1

Frequency: 50 Hz

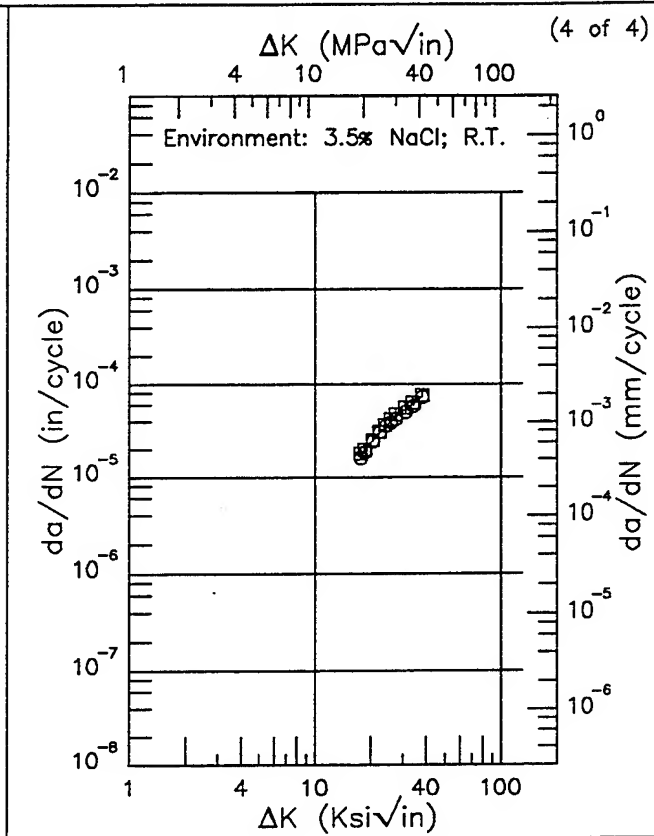
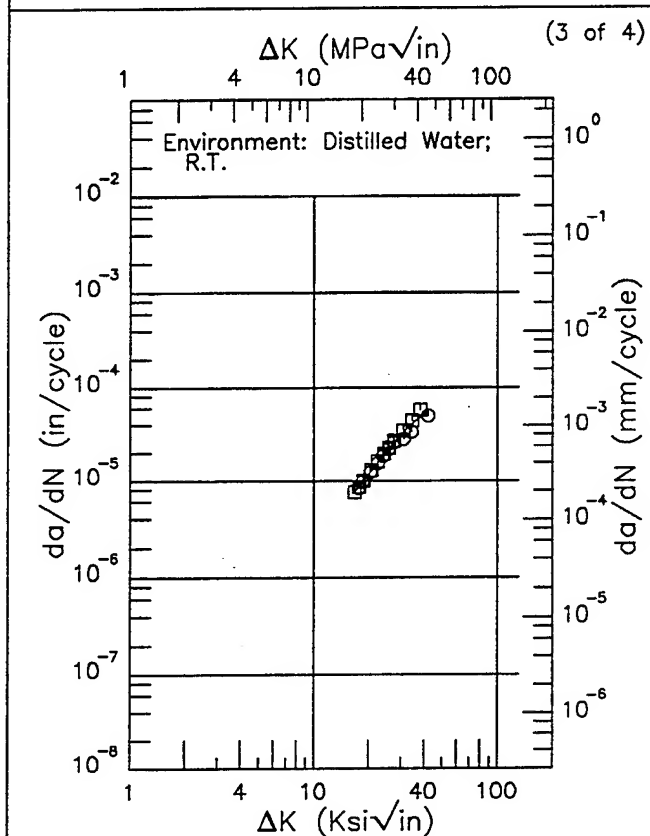
Yield Strength: 122.3 ksi

Ult. Strength: 133.9 ksi

Specimen Thk: 0.083 - 0.084 in.

Specimen Width: 2.754 - 2.756 in.

Ref: 88911



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
16.62 (min)	7.49
20.	11.8
25.	20.4
30.	31.1
35.	42.4
40.	52.7
42.00 (max)	56.3

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
17.57 (min)	16.3
20.	23.5
25.	37.5
30.	50.5
35.	64.2
38.00 (max)	73.6

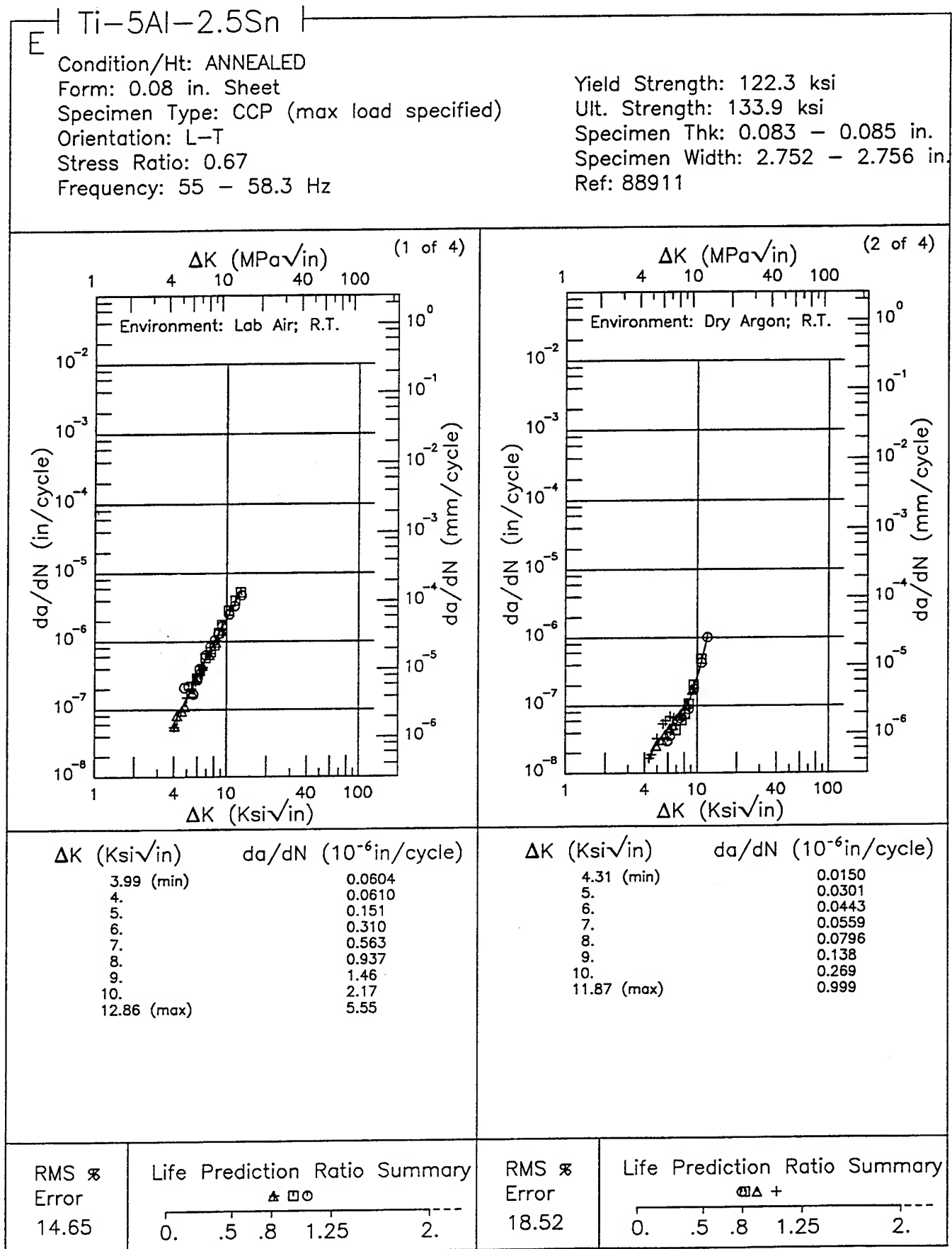
RMS %  
Error  
7.49

Life Prediction Ratio Summary

RMS %  
Error  
4.55

Life Prediction Ratio Summary

Figure 6.11.3.1.2 (Concluded)



**Figure 6.11.3.1.3**

Condition/Ht: ANNEALED

Form: 0.08 in. Sheet

Specimen Type: CCP (max load specified)

Orientation: L-T

Stress Ratio: 0.67

Frequency: 55 - 58.3 Hz

Yield Strength: 122.3 ksi

Ult. Strength: 133.9 ksi

Specimen Thk: 0.083 - 0.085 in.

Specimen Width: 2.752 - 2.756 in.

Ref: 88911

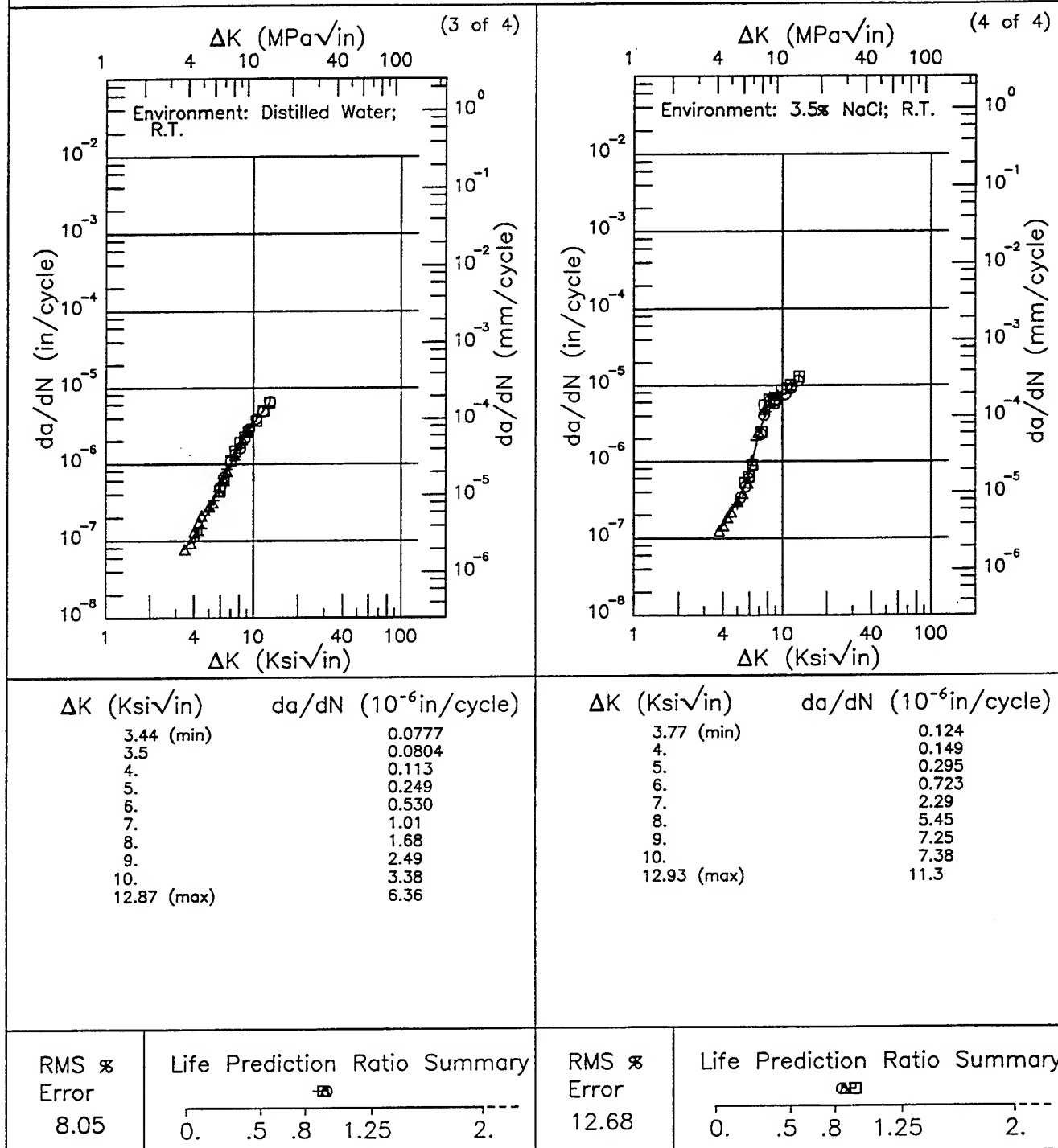


Figure 6.11.3.1.3 (Concluded)



E | Ti-5Al-2.5Sn |

Condition/Ht: ANNEALED

Form: 0.08 in. Sheet

Specimen Type: CCP (max load specified)

Orientation: T-L

Stress Ratio: 0.1

Frequency: 30 Hz

Yield Strength: 125.4 ksi

Ult. Strength: 133.9 - 135.2 ksi

Specimen Thk: 0.083 - 0.085 in.

Specimen Width: 2.753 - 2.757 in.

Ref: 88911

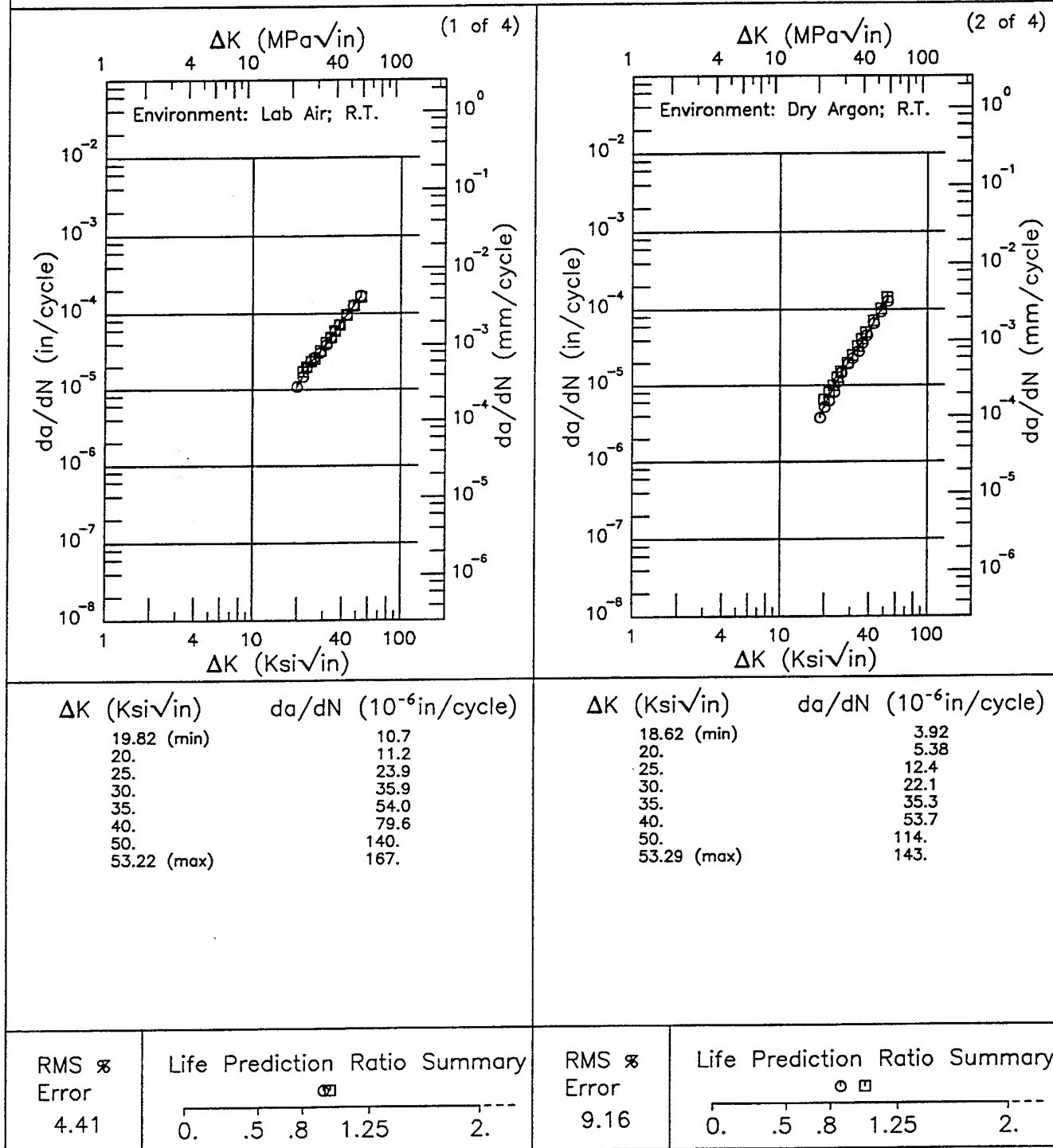


Figure 6.11.3.1.4

Condition/Ht: ANNEALED

Form: 0.08 in. Sheet

Specimen Type: CCP (max load specified)

Orientation: T-L

Stress Ratio: 0.1

Frequency: 30 Hz

Yield Strength: 125.4 ksi

Ult. Strength: 133.9 - 135.2 ksi

Specimen Thk: 0.083 - 0.085 in.

Specimen Width: 2.753 - 2.757 in.

Ref: 88911

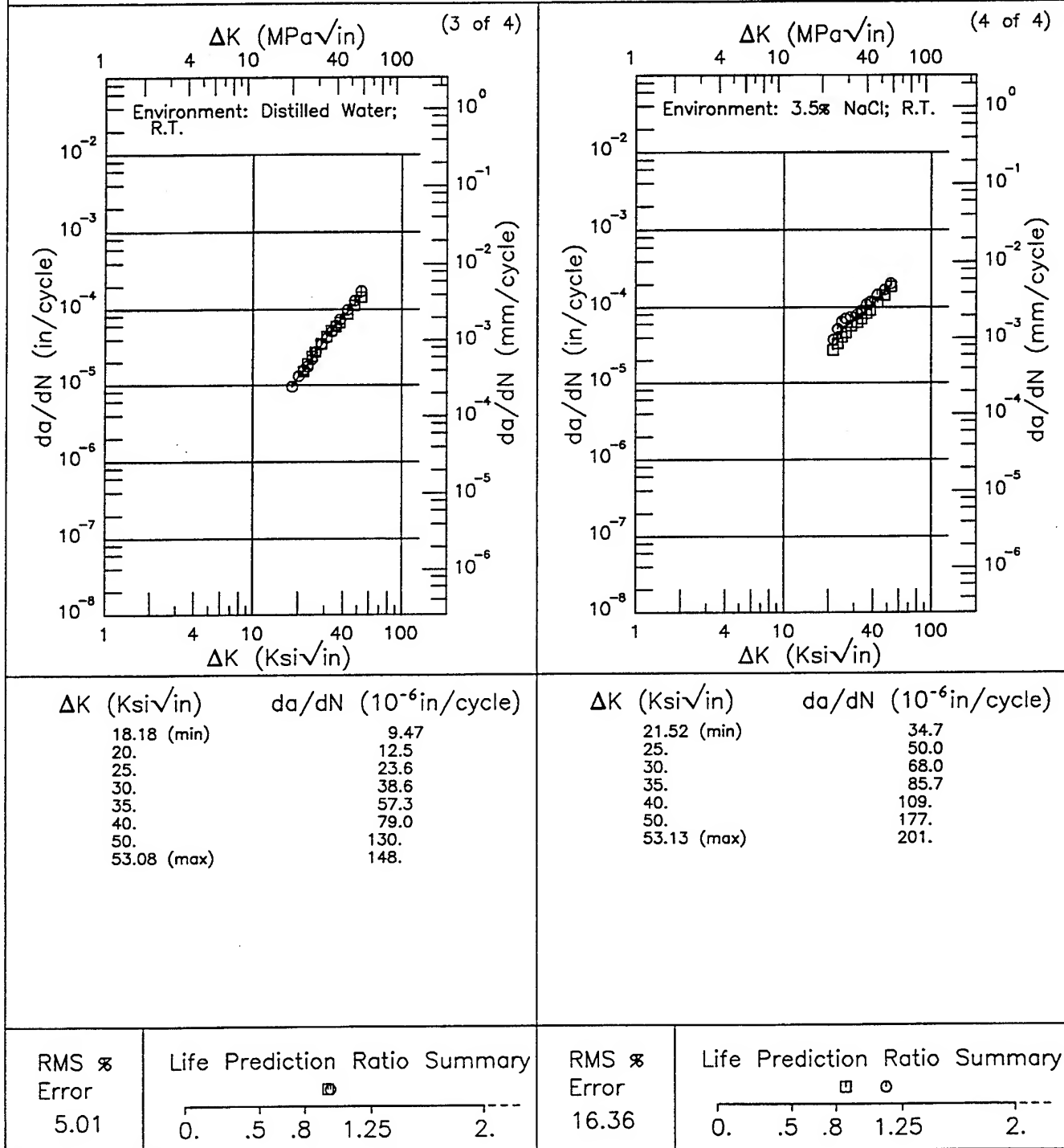


Figure 6.11.3.1.4 (Concluded)

E | Ti-5Al-2.5Sn |

Condition/Ht: ANNEALED

Form: 0.08 in. Sheet

Specimen Type: CCP (max load specified)

Orientation: T-L

Stress Ratio: 0.1

Frequency: 50 - 53.3 Hz

Yield Strength: 125.4 ksi

Ult. Strength: 133.9 - 135.2 ksi

Specimen Thk: 0.083 - 0.085 in.

Specimen Width: 2.755 - 2.756 in.

Ref: 88911

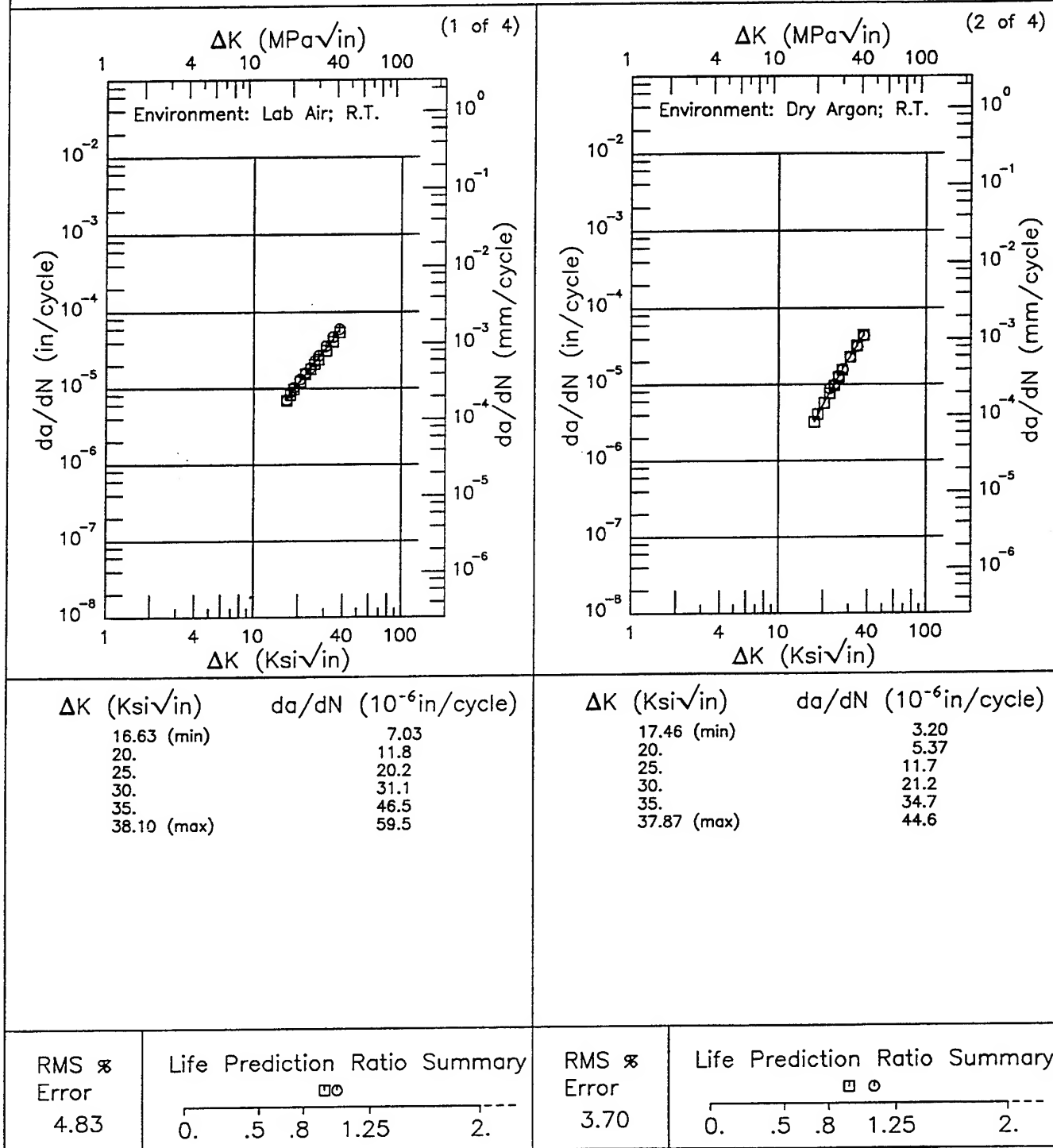
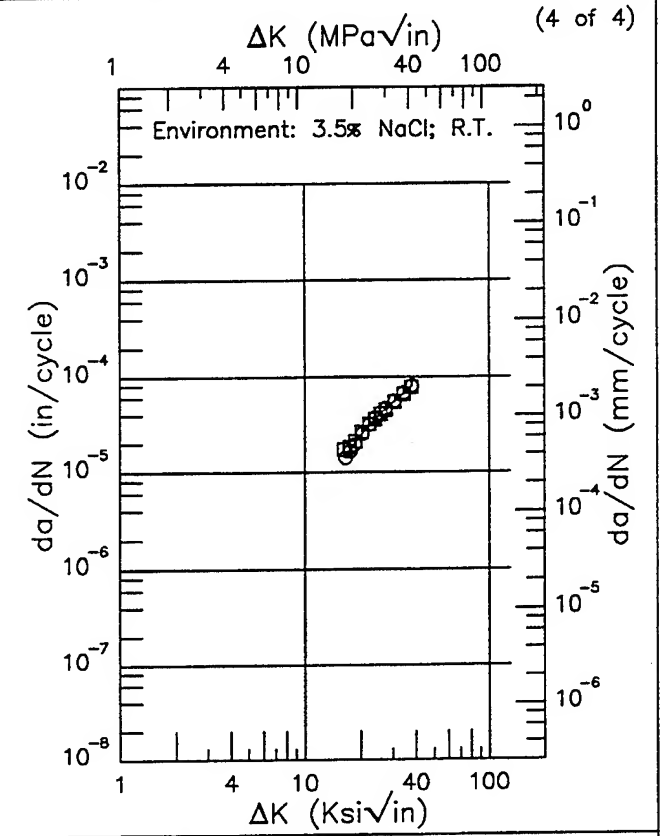
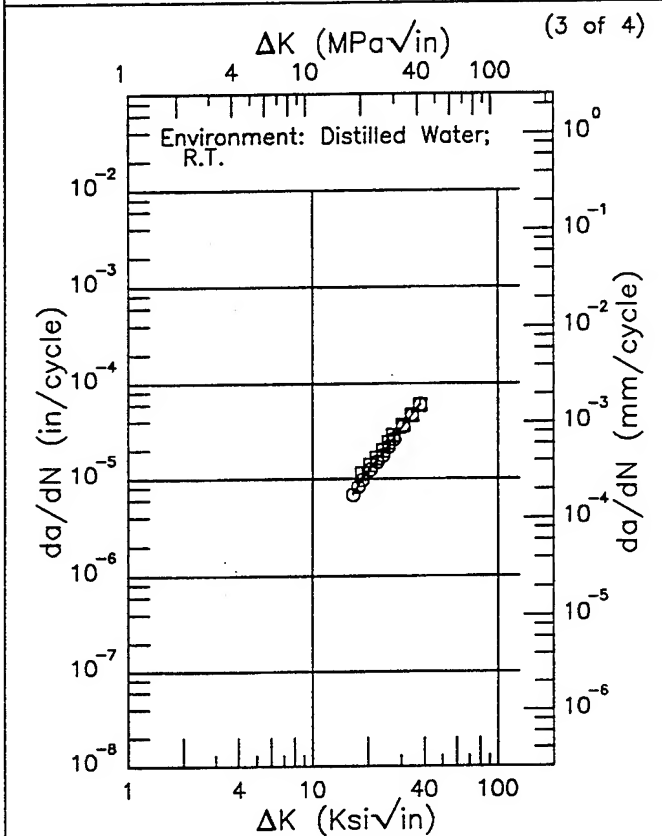


Figure 6.11.3.1.5

Condition/Ht: ANNEALED  
 Form: 0.08 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation: T-L  
 Stress Ratio: 0.1  
 Frequency: 50 - 53.3 Hz

Yield Strength: 125.4 ksi  
 Ult. Strength: 133.9 - 135.2 ksi  
 Specimen Thk: 0.083 - 0.085 in.  
 Specimen Width: 2.755 - 2.756 in.  
 Ref: 88911



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
16.57 (min)	7.01
20.	12.0
25.	21.3
30.	33.4
35.	49.2
37.79 (max)	59.9

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
16.28 (min)	14.2
20.	24.4
25.	39.3
30.	53.4
35.	69.6
37.84 (max)	79.0

RMS % Error	Life Prediction Ratio Summary
5.76	

RMS % Error	Life Prediction Ratio Summary
5.01	

Figure 6.11.3.1.5 (Concluded)

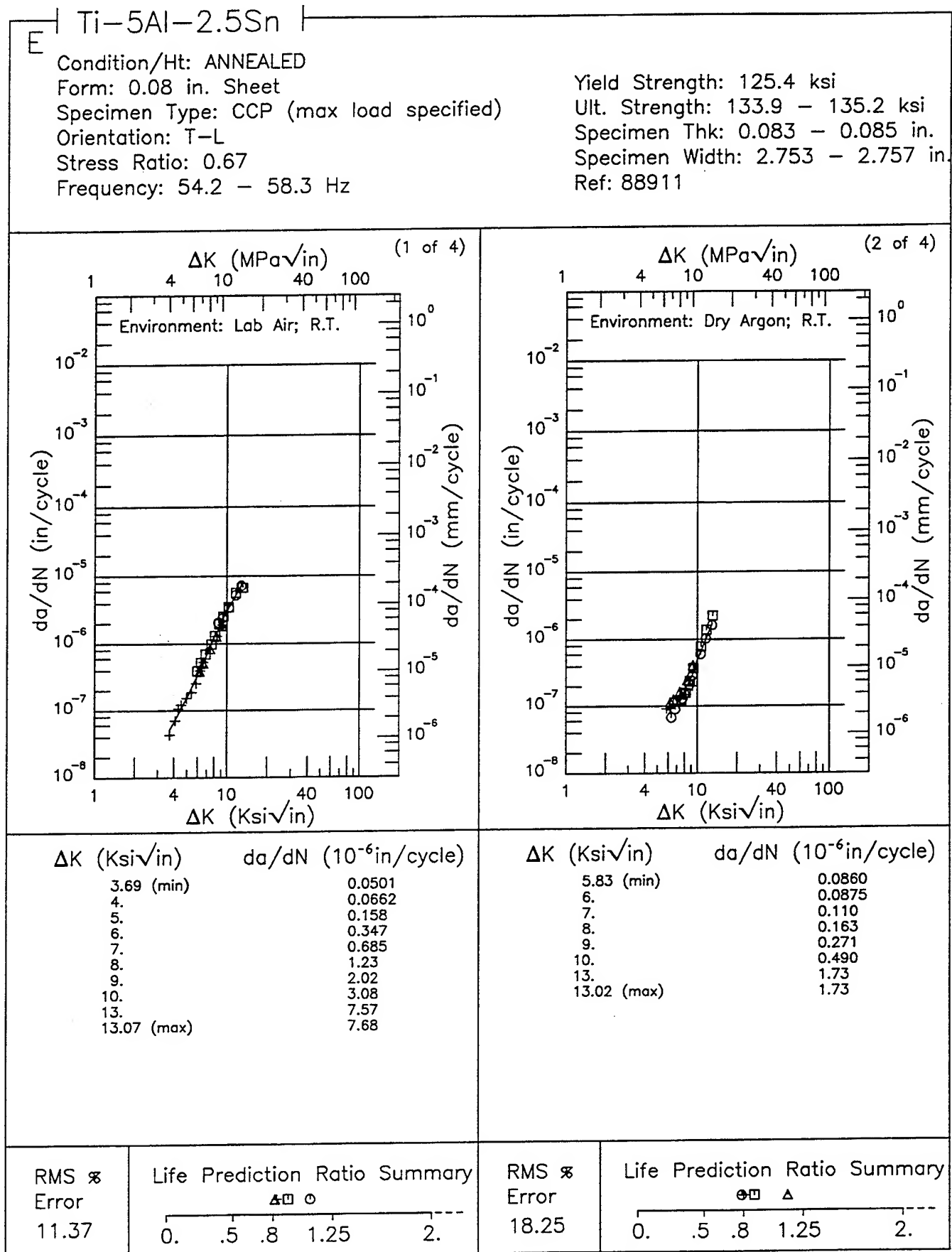


Figure 6.11.3.1.6

Condition/Ht: ANNEALED  
 Form: 0.08 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation: T-L  
 Stress Ratio: 0.67  
 Frequency: 54.2 - 58.3 Hz

Yield Strength: 125.4 ksi  
 Ult. Strength: 133.9 - 135.2 ksi  
 Specimen Thk: 0.083 - 0.085 in.  
 Specimen Width: 2.753 - 2.757 in.  
 Ref: 88911

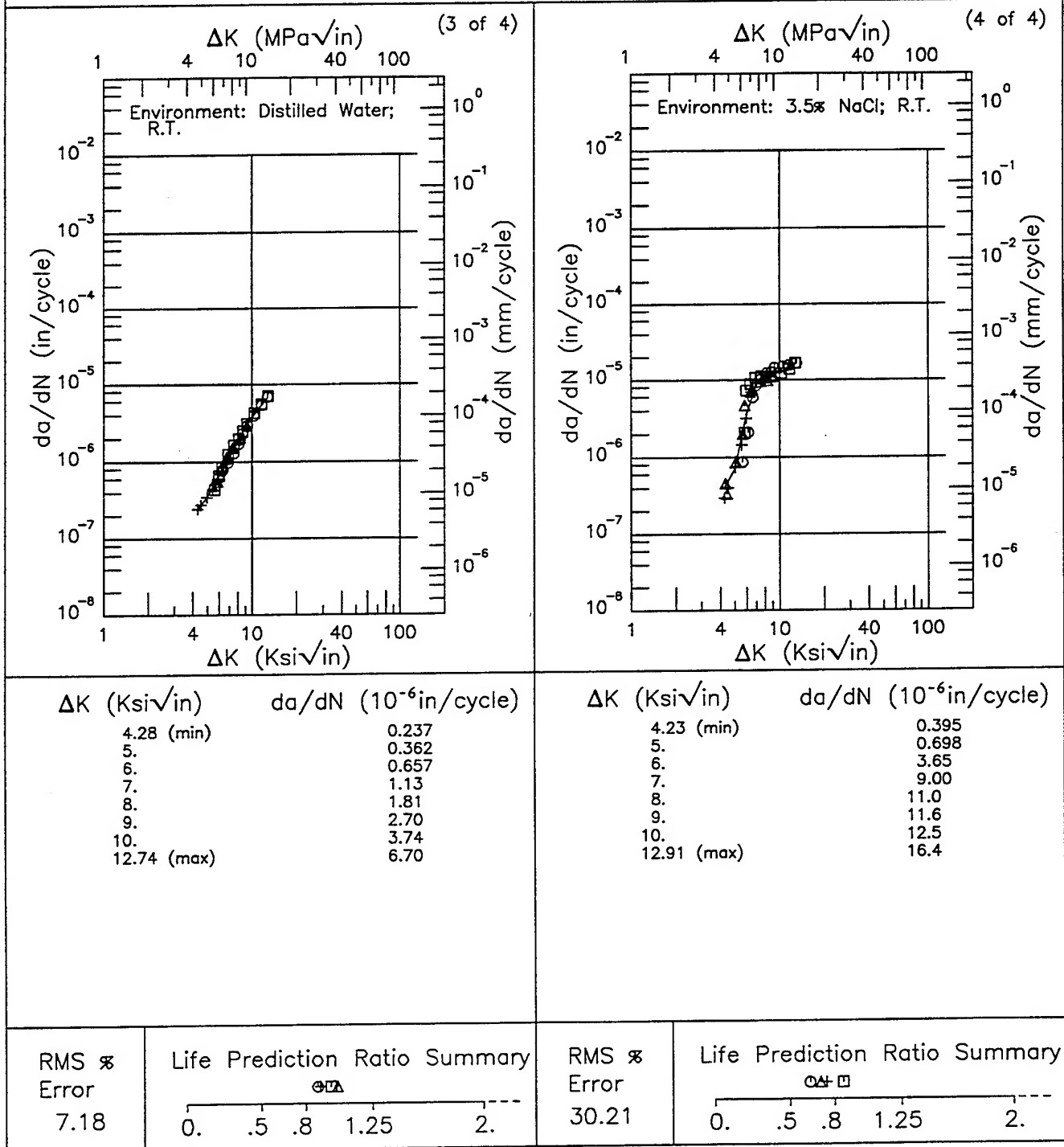


Figure 6.11.3.1.6 (Concluded)

TABLE 6.12.1.2.1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6-2-2-2-2 AT ROOM TEMPERATURE**

**ORIENTATION: L-T**                      **ENVIRONMENT: 3.5% NaCl**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ST	PLATE	0.1	1			2.08	48.4	526.69	
		0.1	20		0.3	4.67	31.94		
STA	PLATE	0.1	1				75.53		
		0.1	20		0.46	6.14	18.94		

1 of 1

TABLE 6.12.1.2.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-6-2-2-2-2 AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: H.H.A.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $K\text{si}/\sqrt{\text{in}}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
ST	PLATE	0.1	1			2.36	13.66	285.45	
		0.1	20			1.45	11.42	104.74	
STA	PLATE	0.1	1			1.93	17.04	418.61	
		0.1	20		0.17	2.34	13.68		



TABLE 6.12.2.1

TITANIUM Ti-6Al-2Sn-2Zr-2Mo-2Cr-0.25Si K <sub>IC</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>IC</sub> /TYS) <sup>3</sup> (in.)	K <sub>IC</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>IC</sub> (Ksi√in.)	K <sub>IC</sub> MEAN	STAN DEV		
1740F 1 HR AC	Plate	0.62	R.T.	L-T	148.0	2.000	0.625	CT	1.000	0.45	62.90	61.6	1.6	1974	88186
		0.62			148.0	2.000	0.625	CT	1.000	0.41	59.80			1974	88186
		0.62			148.0	2.000	0.626	CT	1.000	0.44	62.00			1974	88186
STA-1740F 1 HR AC 1000F 8HR AC	Plate	0.62	R.T.	L-T	157.0	2.000	0.625	CT	1.000	0.30	54.30	55.3	1.5	1974	88186
		0.62			157.0	2.000	0.624	CT	1.000	0.33	57.00			1974	88186
		0.62			157.0	2.000	0.625	CT	1.000	0.30	54.70			1974	88186

**This page intentionally left blank**

EF Ti-6-2-2-2-2

Condition/Ht: ST  
Form: 0.63 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.1

Yield Strength: 157 ksi  
Ult. Strength:  
Specimen Thk: 0.151 - 0.152 in.  
Specimen Width: 3 in.  
Ref: 86844

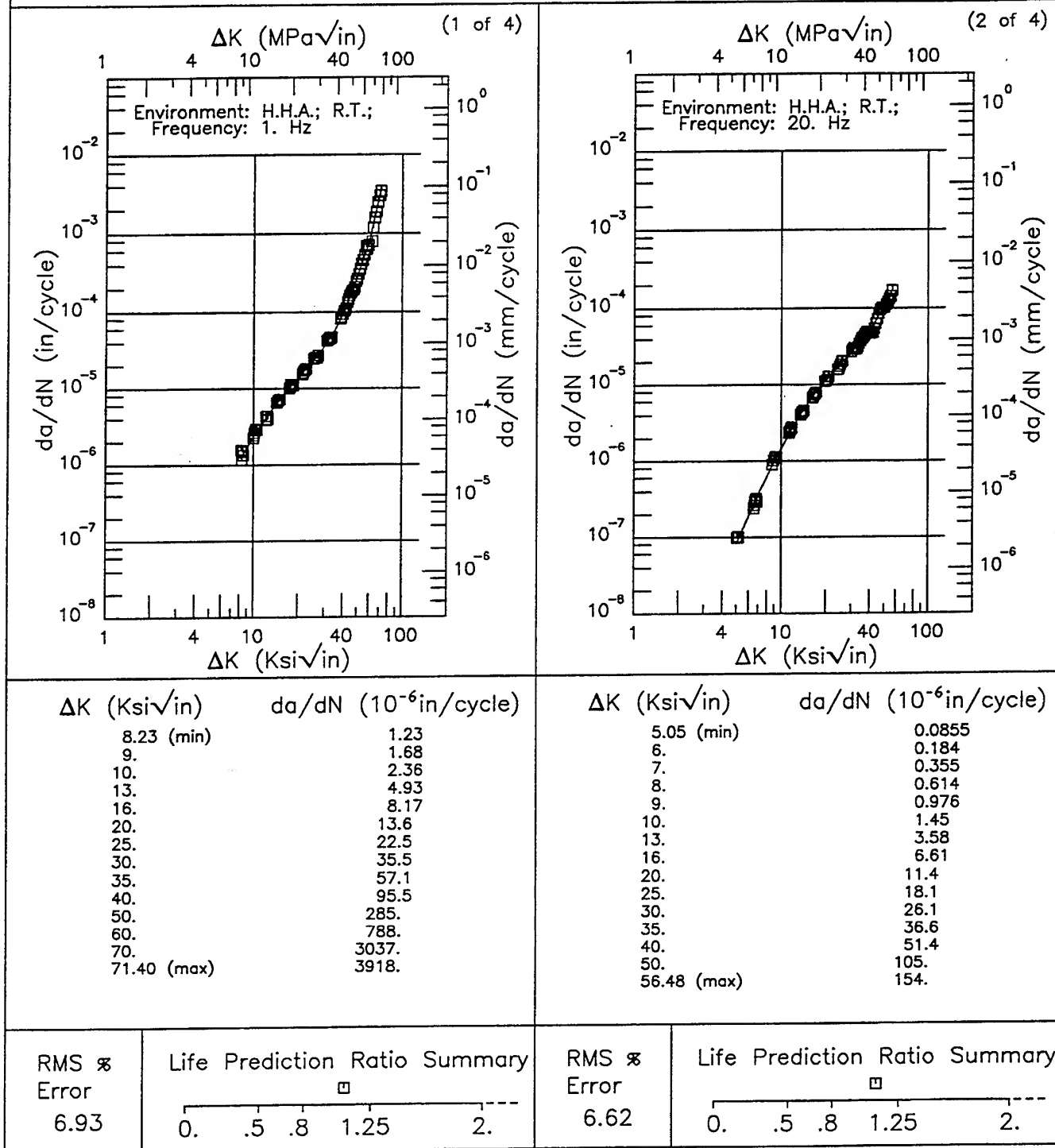


Figure 6.12.3.1.1

Condition/Ht: ST  
Form: 0.63 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.1

Yield Strength: 157 ksi  
Ult. Strength:  
Specimen Thk: 0.151 - 0.152 in.  
Specimen Width: 3 in.  
Ref: 86844

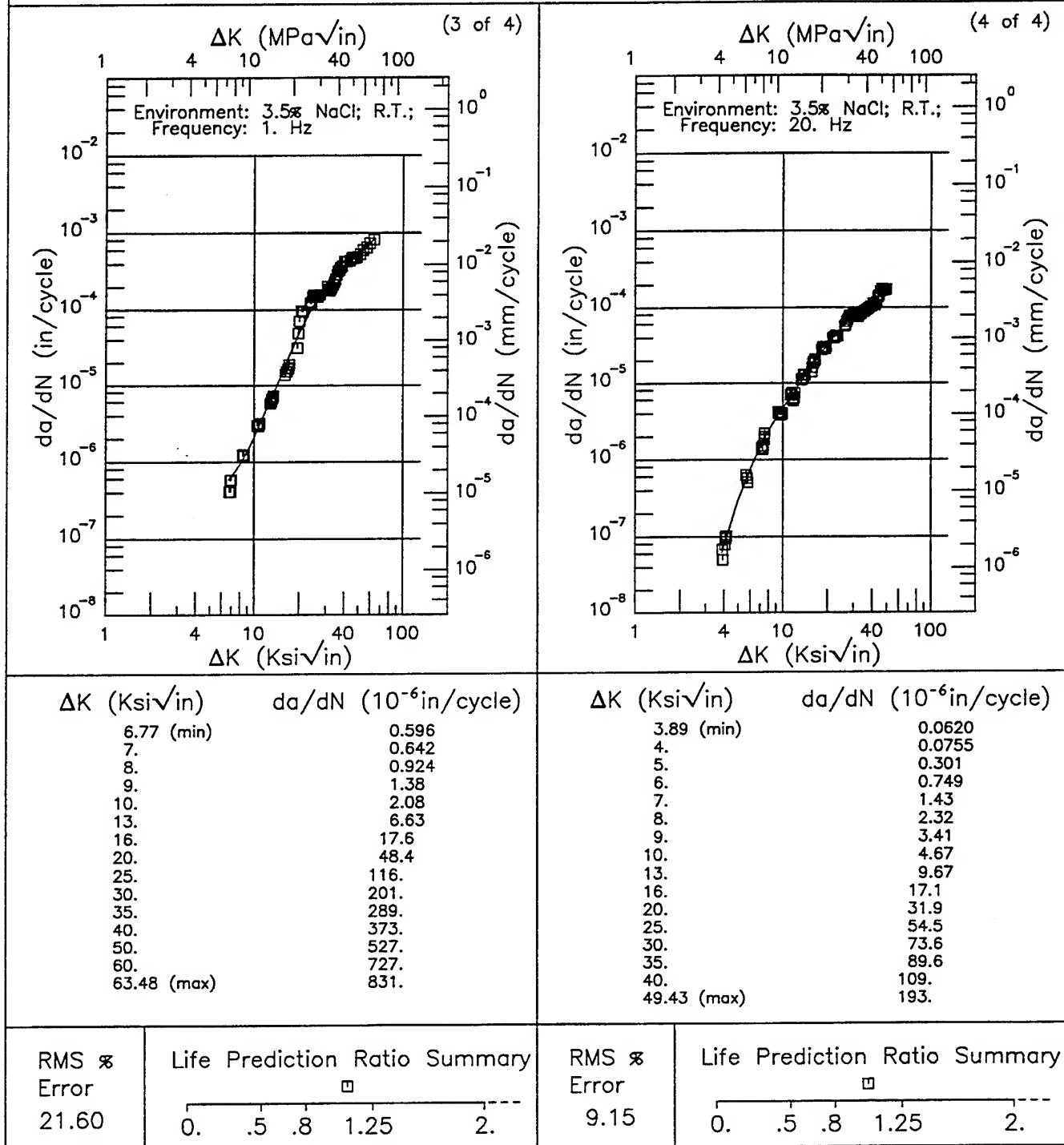


Figure 6.12.3.1.1 (Concluded)

EF

Ti-6-2-2-2-2

Condition/Ht: STA  
 Form: 0.63 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.1

Yield Strength: 157 ksi  
 Ult. Strength:  
 Specimen Thk: 0.143 - 0.147 in.  
 Specimen Width: 3 in.  
 Ref: 86844

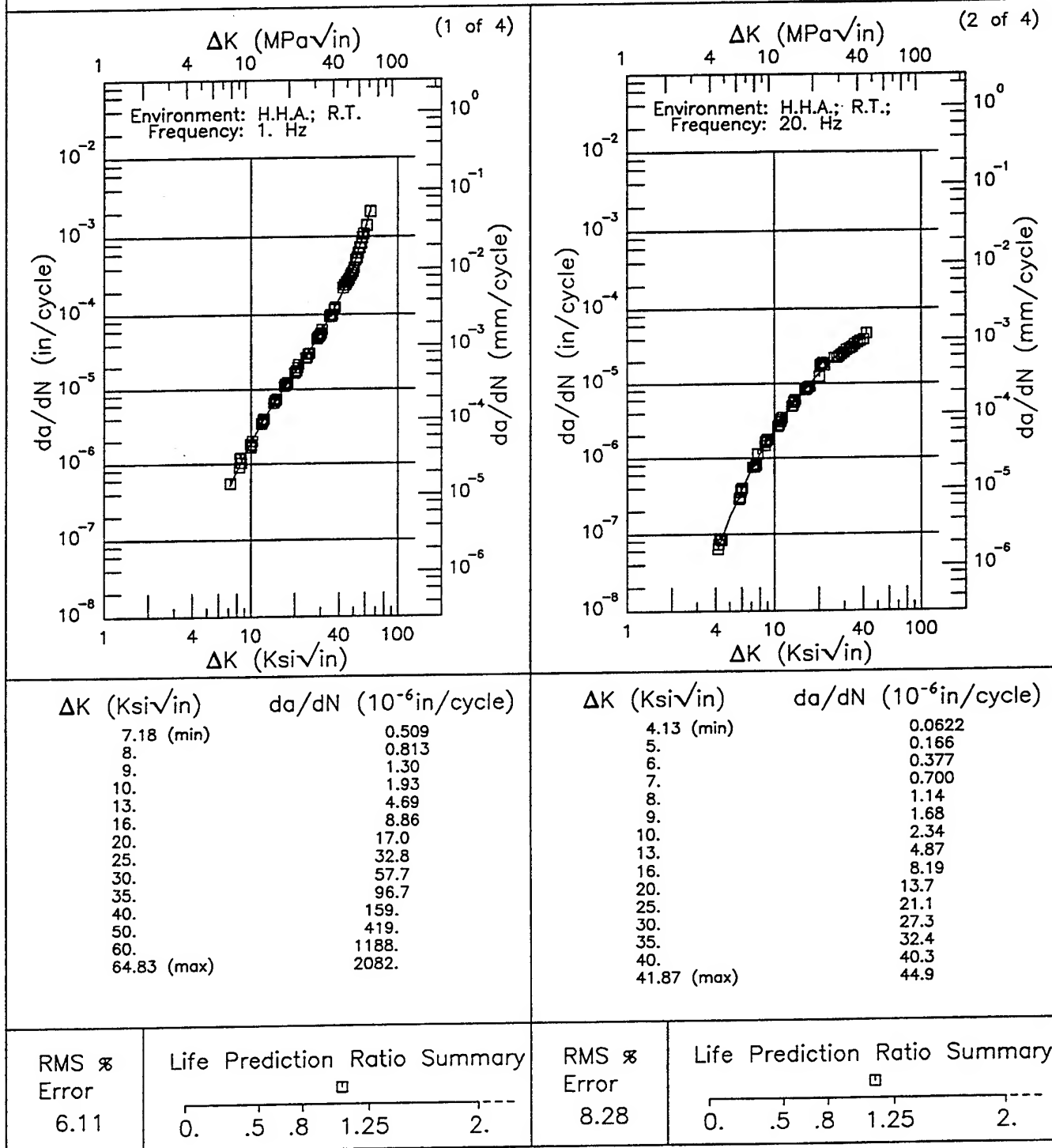


Figure 6.12.3.1.2

Condition/Ht: STA  
Form: 0.63 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.1

Yield Strength: 157 ksi  
Ult. Strength:  
Specimen Thk: 0.143 - 0.147 in.  
Specimen Width: 3 in.  
Ref: 86844

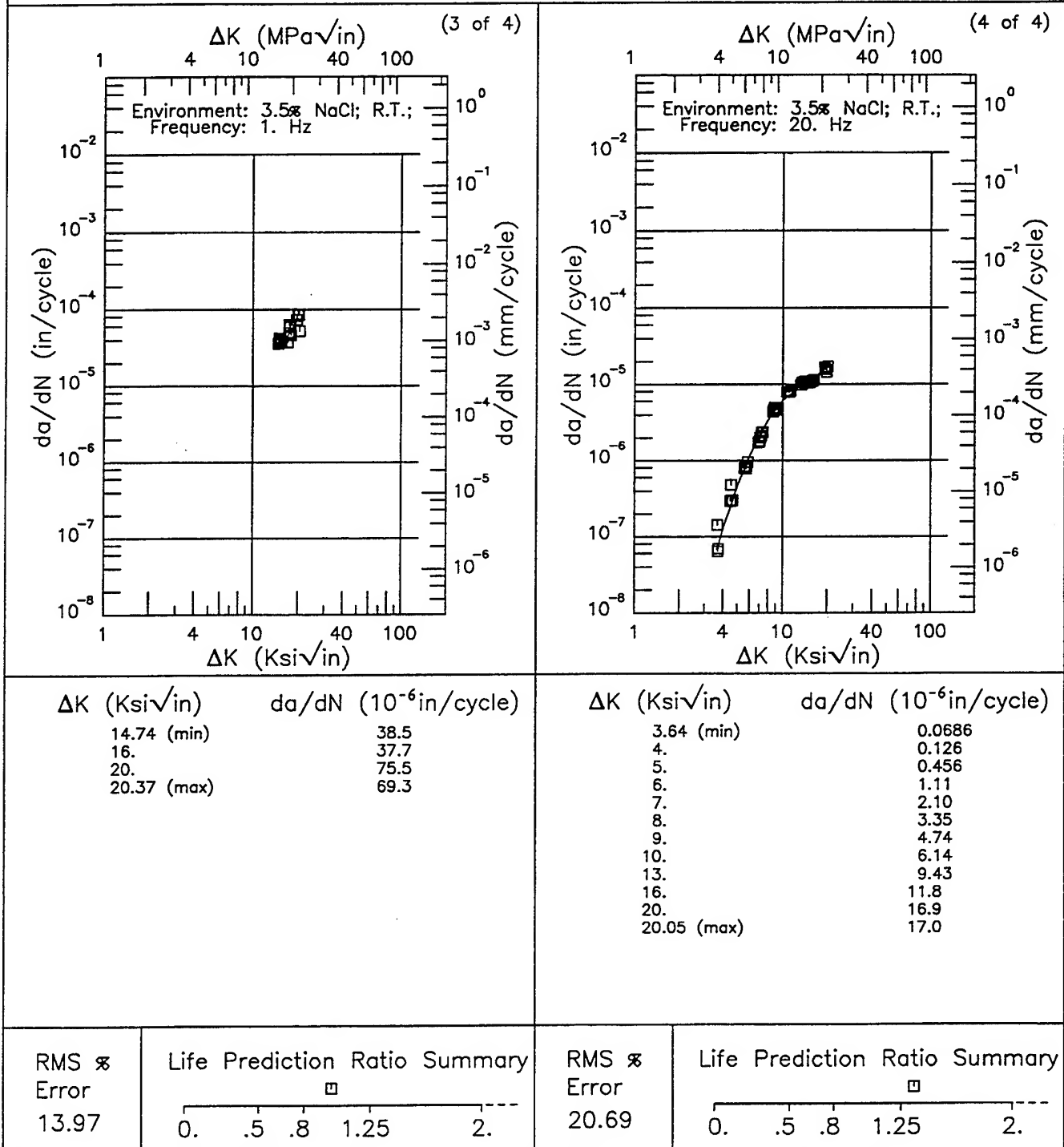


Figure 6.12.3.1.2 (Concluded)

TABLE 6.13.1.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6-2-4-2 AT ROOM TEMPERATURE**

ORIENTATION: C-R

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
1700F 1HR AC 1100F 8HR AC	FORGING	0.1	0.16				10		
		0.5	0.16			2.3			

**This page intentionally left blank**



EF | Ti-6-2-4-2 |

Condition/Ht: 1790F 1HR AC 1100F 8HR AC  
 Form: 2 in. Forging  
 Specimen Type: CCP (max load specified)  
 Orientation: C-R  
 Stress Ratio: 0.1

Yield Strength: 139.4 - 140.9 ksi  
 Ult. Strength: 151.6 - 152.3 ksi  
 Specimen Thk: 0.073 - 0.083 in.  
 Specimen Width: 1.75 in.  
 Ref: PW002

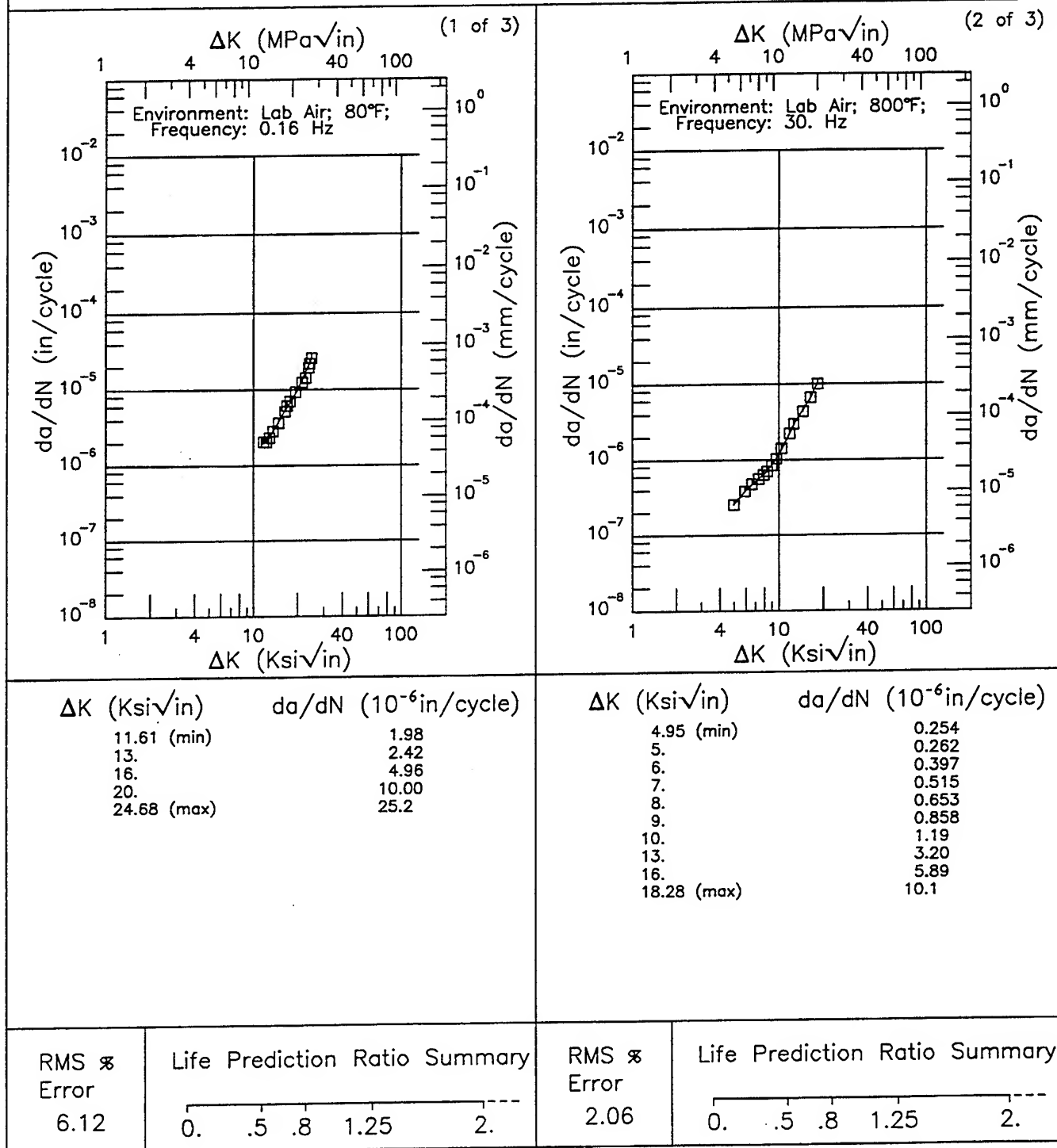


Figure 6.13.3.1.1

Condition/Ht: 1790F 1HR AC 1100F 8HR AC  
 Form: 2 in. Forging  
 Specimen Type: CCP (max load specified)  
 Orientation: C-R  
 Stress Ratio: 0.1

Yield Strength: 139.4 - 140.9 ksi  
 Ult. Strength: 151.6 - 152.3 ksi  
 Specimen Thk: 0.073 - 0.083 in.  
 Specimen Width: 1.75 in.  
 Ref: PW002

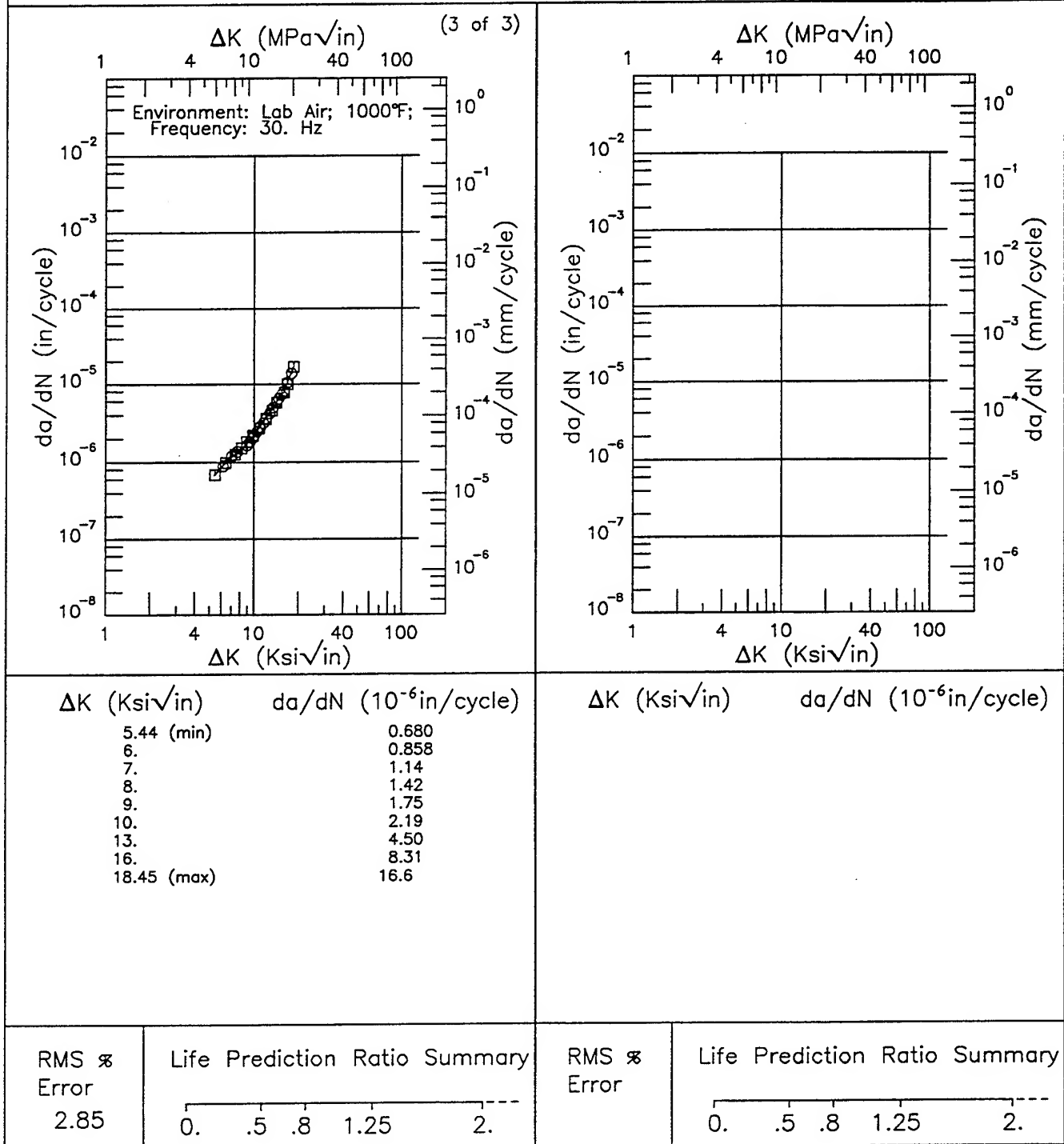


Figure 6.13.3.1.1 (Concluded)

EF | Ti-6-2-4-2 |

Condition/Ht: 1790F 1HR AC 1100F 8HR AC  
 Form: 2 in. Forging  
 Specimen Type: CCP (max load specified)  
 Orientation: C-R  
 Stress Ratio: 0.5

Yield Strength: 139.4 – 140.9 ksi  
 Ult. Strength: 151.6 – 152.3 ksi  
 Specimen Thk: 0.074 – 0.082 in.  
 Specimen Width: 1.75 in.  
 Ref: PW002

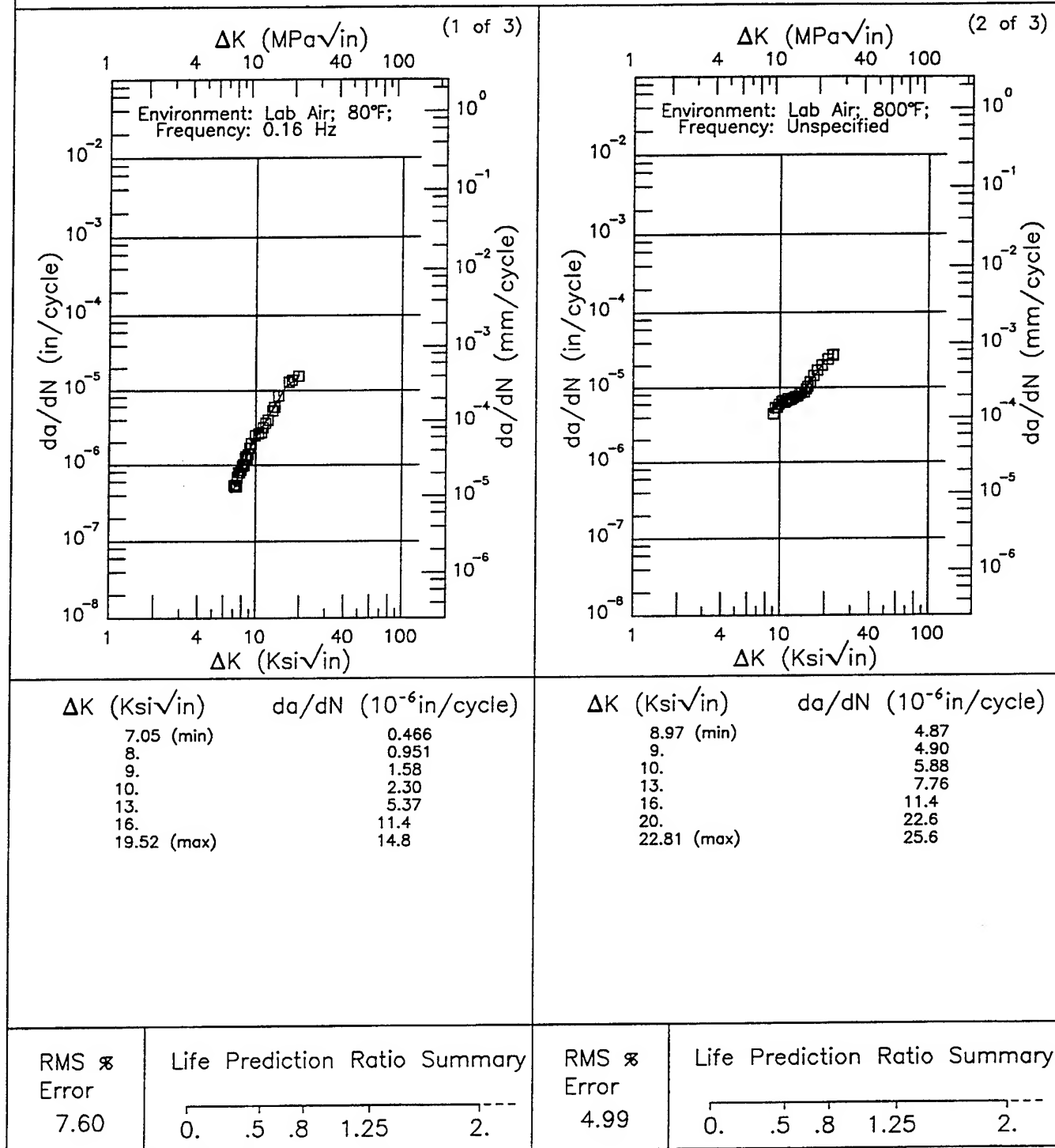


Figure 6.13.3.1.2

Condition/Ht: 1790F 1HR AC 1100F 8HR AC  
 Form: 2 in. Forging  
 Specimen Type: CCP (max load specified)  
 Orientation: C-R  
 Stress Ratio: 0.5

Yield Strength: 139.4 - 140.9 ksi  
 Ult. Strength: 151.6 - 152.3 ksi  
 Specimen Thk: 0.074 - 0.082 in.  
 Specimen Width: 1.75 in.  
 Ref: PW002

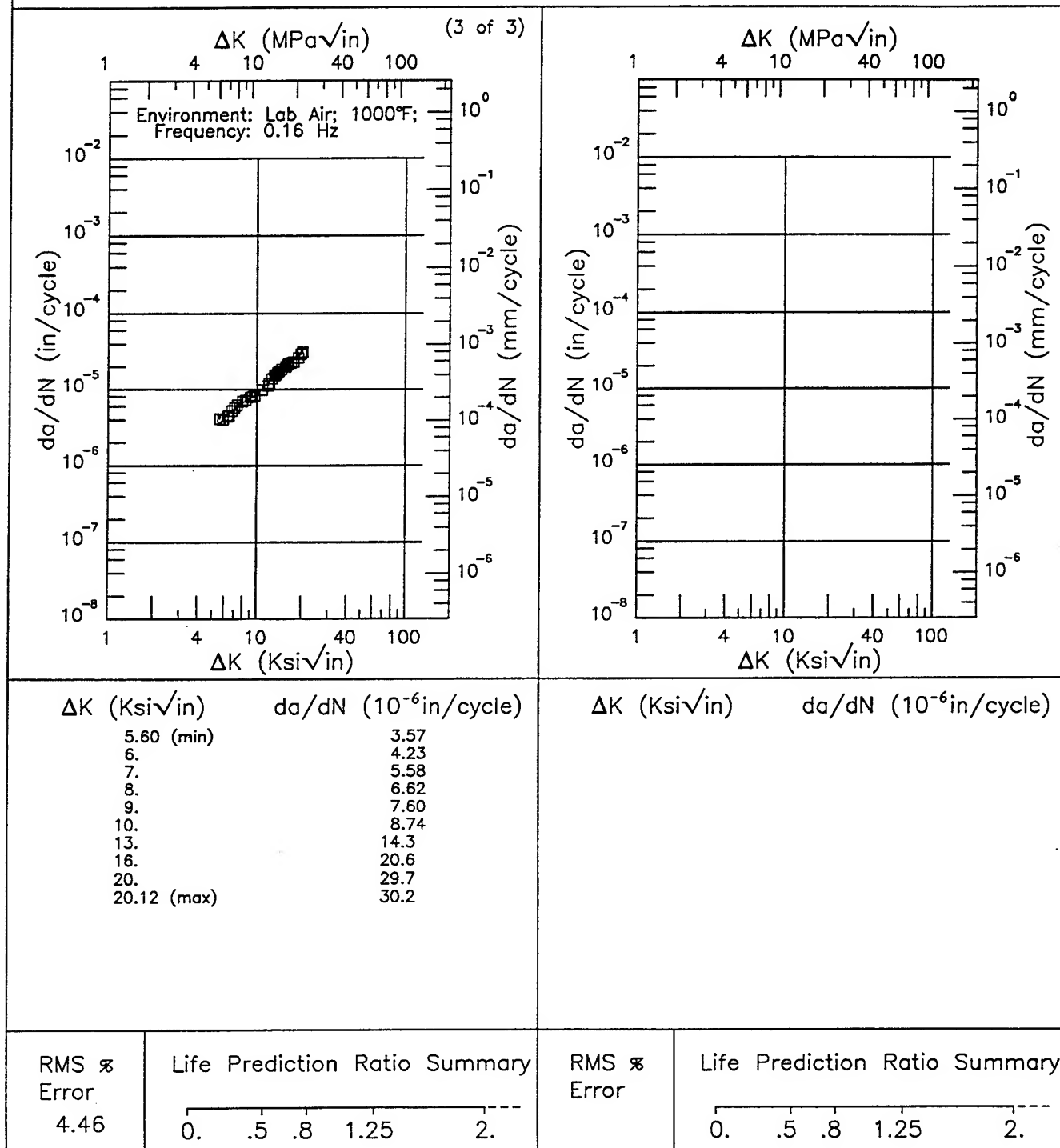


Figure 6.13.3.1.2 (Concluded)

EF

Ti-6-2-4-2

Condition/Ht: 1790F 1HR AC 1100F 8HR AC  
 Form: 2 in. Forging  
 Specimen Type: CCP (max load specified)  
 Orientation: C-R  
 Stress Ratio: 0.7

Yield Strength: 135.5 - 140.9 ksi  
 Ult. Strength: 148.5 - 152.3 ksi  
 Specimen Thk: 0.08 - 0.081 in.  
 Specimen Width: 1.75 in.  
 Ref: PW002

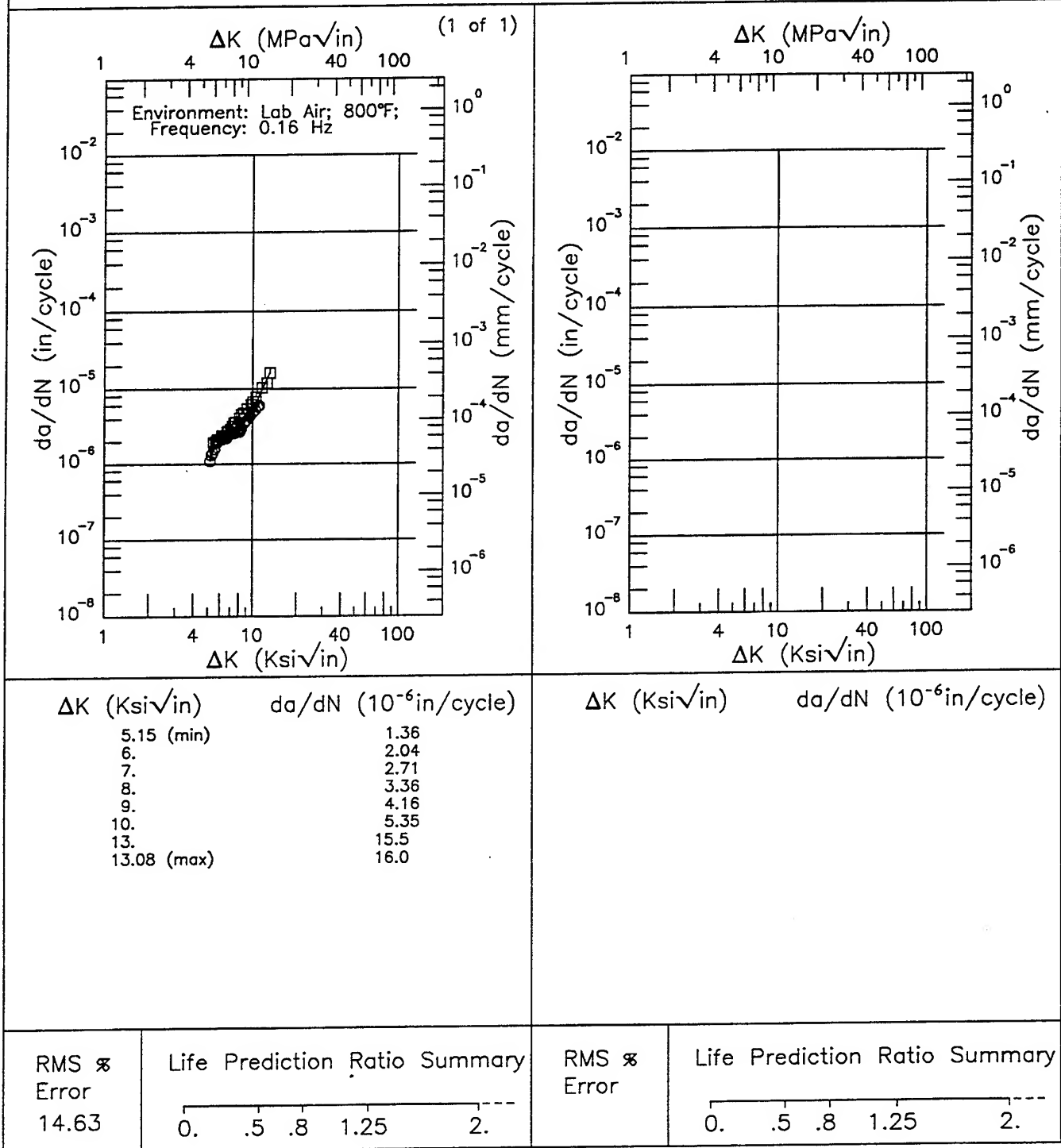


Figure 6.13.3.1.3

TABLE 6.14.1.2.1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6-2-4-2 ELI AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
ANNEAL 1450F 1HR AC	PLATE	-0.3	9				21.3		
		0.1	9				13.49		
		0.5	9				43.6		

TABLE 6.14.1.2.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6-2-4-2 ELI AT ROOM TEMPERATURE**

ORIENTATION: L-T		ENVIRONMENT: Vacuum						
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)				
				$\Delta K$ Level ( $Ksi\sqrt{in}$ )				
				2.5	5.0	10.0	20.0	50.0
ANNEAL 1450F 1HR AC	PLATE	0.1	9				6.63	
								100.0

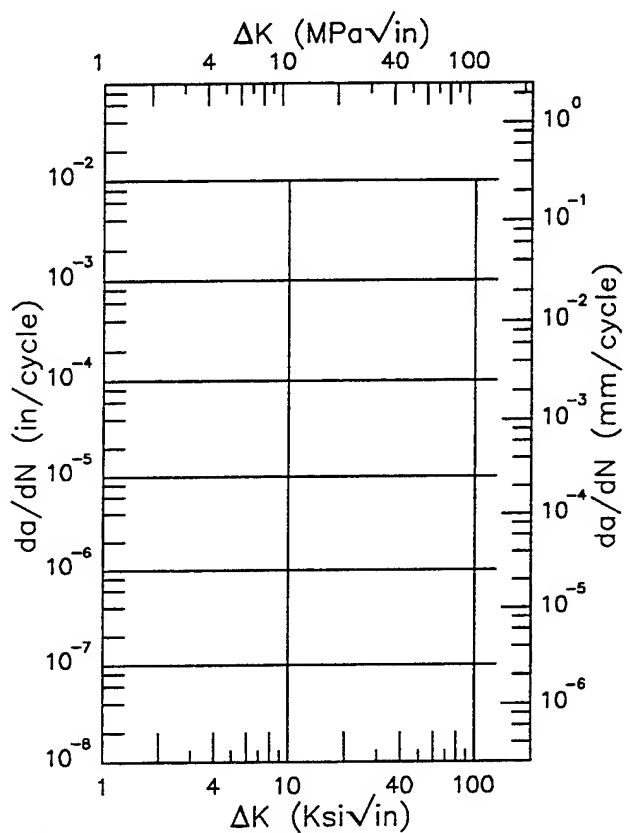
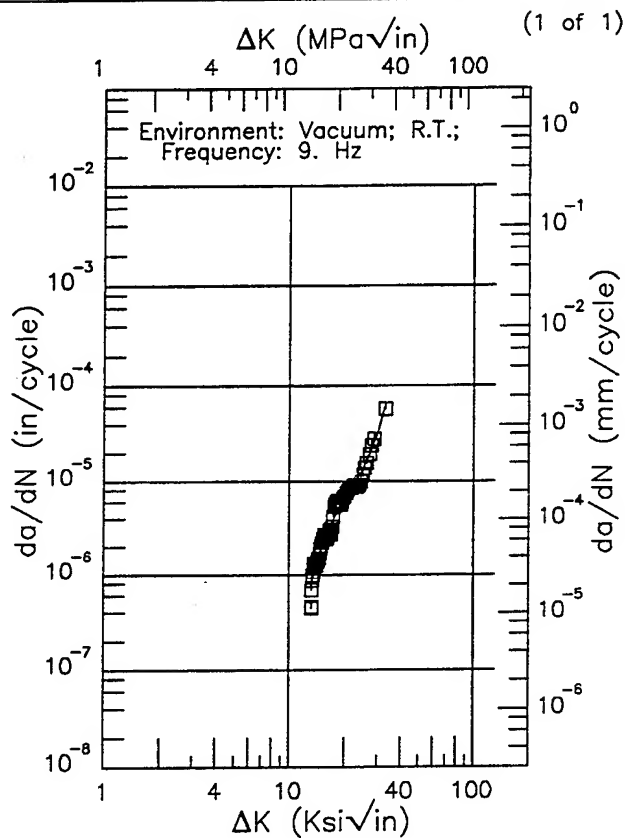
**This page intentionally left blank**



EF | Ti-6-2-4-2 ELI |

Condition/Ht: ANNEAL 1450F 1HR AC  
 Form: 0.75 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.1

Yield Strength: 140 ksi  
 Ult. Strength: 149 ksi  
 Specimen Thk: 0.187 in.  
 Specimen Width: 1.5 in.  
 Ref: MA016



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ (10 <sup>-6</sup> in/cycle)
13.18 (min)	0.825
16.	2.89
20.	6.63
25.	13.3
30.	31.5
32.99 (max)	60.9

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  (10<sup>-6</sup>in/cycle)

RMS %  
Error  
15.85

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

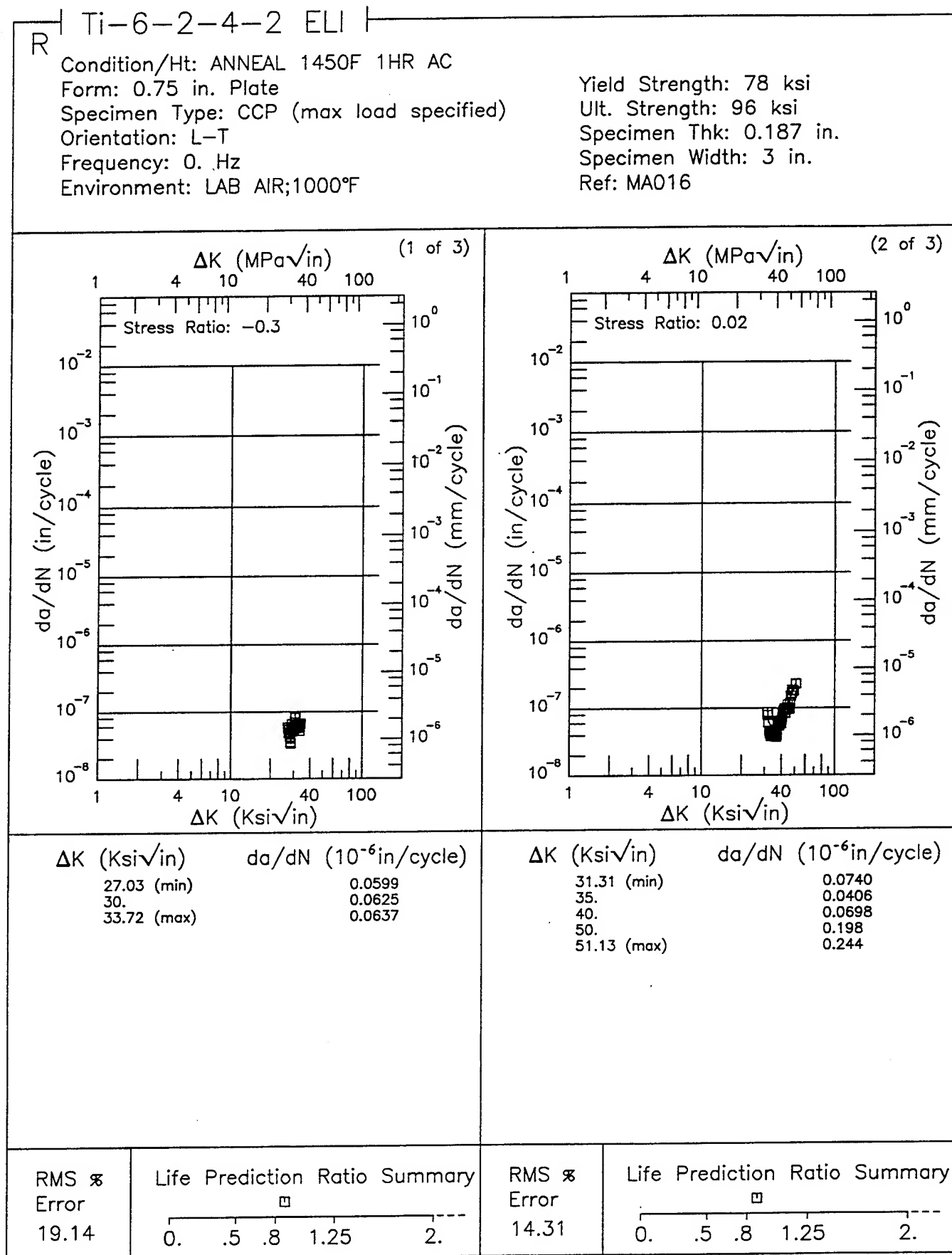
RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

Figure 6.14.3.1.1

**This page intentionally left blank**



**Figure 6.14.3.1.2**

Condition/Ht: ANNEAL 1450F 1HR AC  
 Form: 0.75 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Frequency: 0. Hz  
 Environment: LAB AIR;1000°F

Yield Strength: 78 ksi  
 Ult. Strength: 96 ksi  
 Specimen Thk: 0.187 in.  
 Specimen Width: 3 in.  
 Ref: MA016

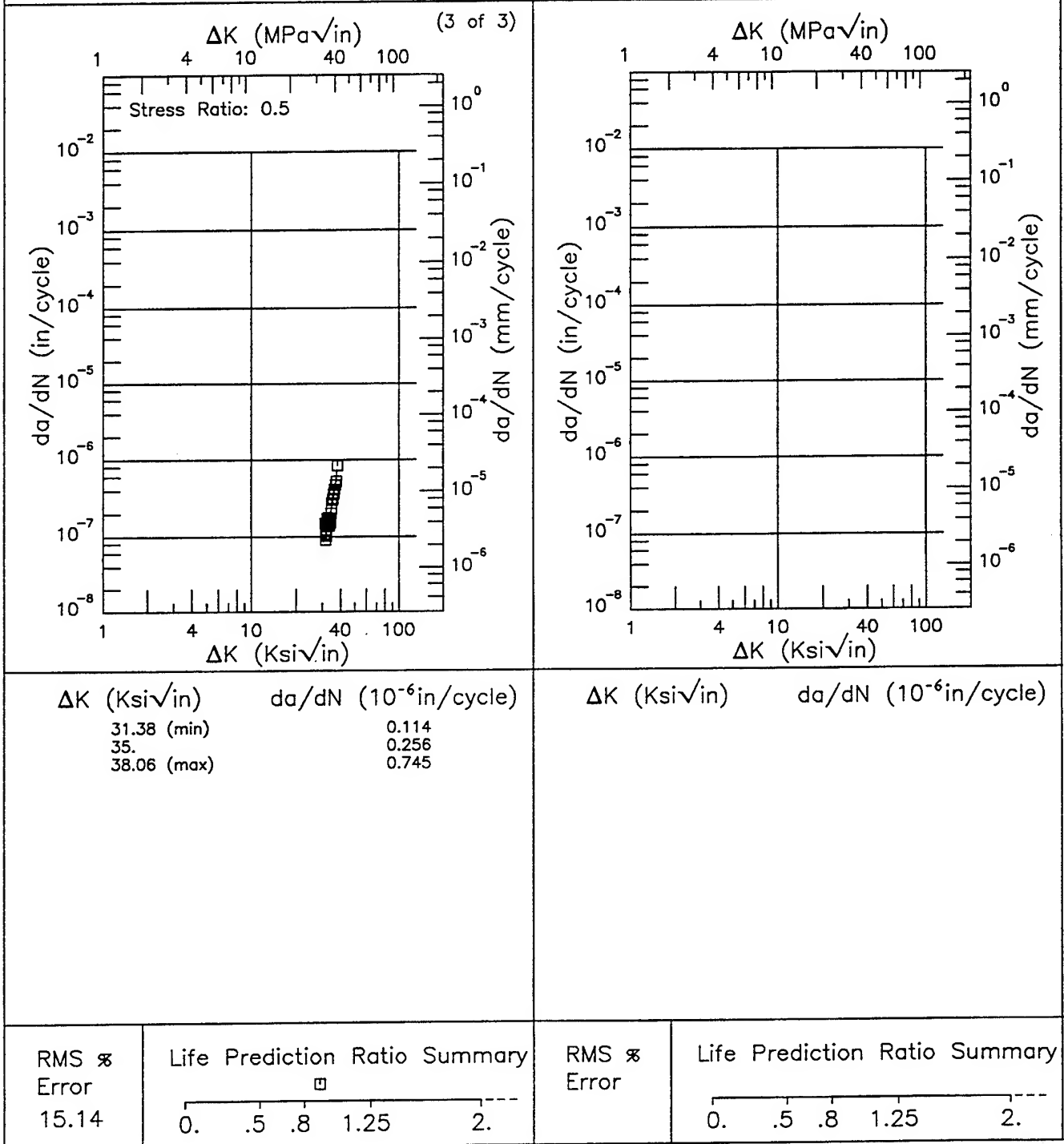


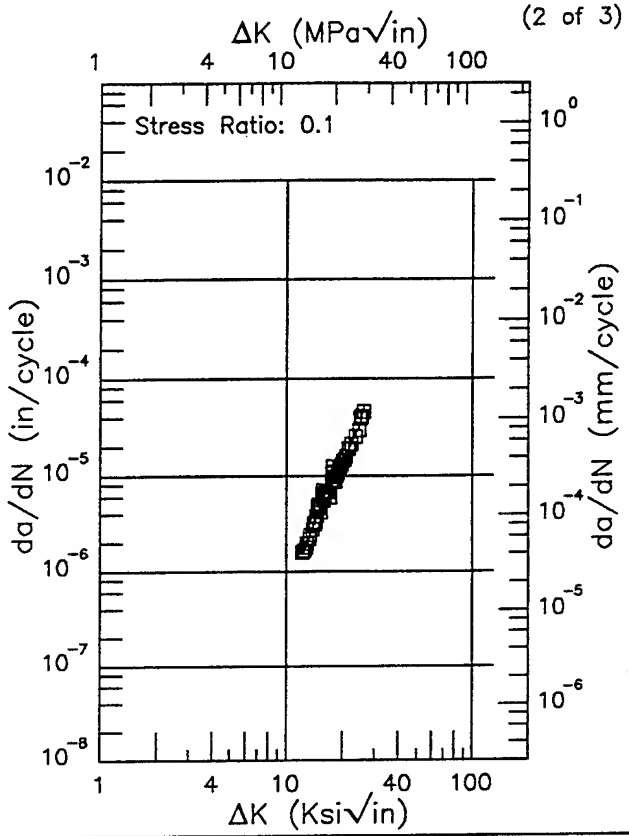
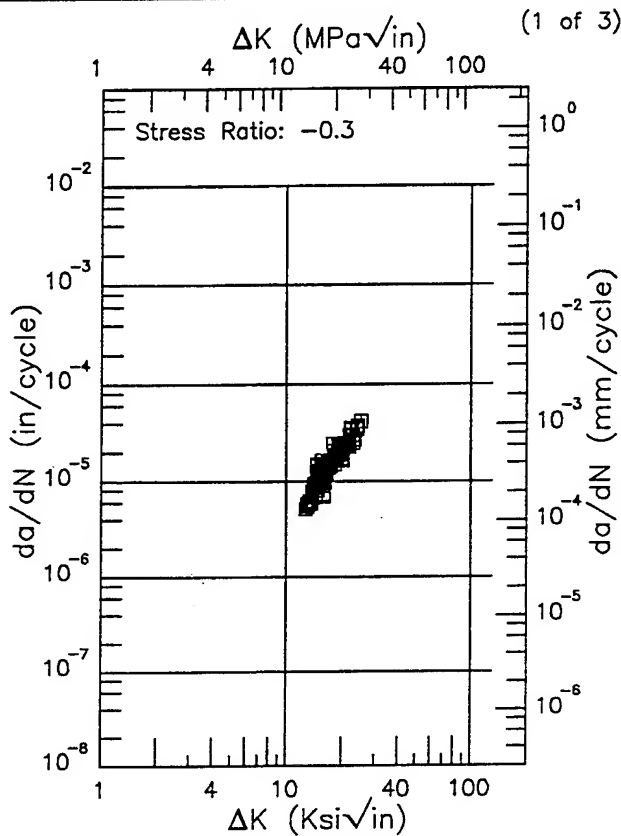
Figure 6.14.3.1.2 (Concluded)

R

Ti-6-2-4-2. ELI

Condition/Ht: ANNEAL 1450F 1HR AC  
 Form: 0.75 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Frequency: 9 Hz  
 Environment: LAB AIR; RT

Yield Strength: 140 ksi  
 Ult. Strength: 149 ksi  
 Specimen Thk: 0.187 in.  
 Specimen Width: 3 in.  
 Ref: MA016



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
12.73 (min)	4.93
13.	5.61
16.	13.2
20.	21.3
25.	40.9
25.15 (max)	42.0

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
12.17 (min)	1.52
13.	2.05
16.	6.09
20.	13.5
25.	34.2
26.03 (max)	48.3

RMS % Error	Life Prediction Ratio Summary
18.34	

RMS % Error	Life Prediction Ratio Summary
12.45	

Figure 6.14.3.1.3

Condition/Ht: ANNEAL 1450F 1HR AC  
 Form: 0.75 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Frequency: 9 Hz  
 Environment: LAB AIR; RT

Yield Strength: 140 ksi  
 Ult. Strength: 149 ksi  
 Specimen Thk: 0.187 in.  
 Specimen Width: 3 in.  
 Ref: MA016

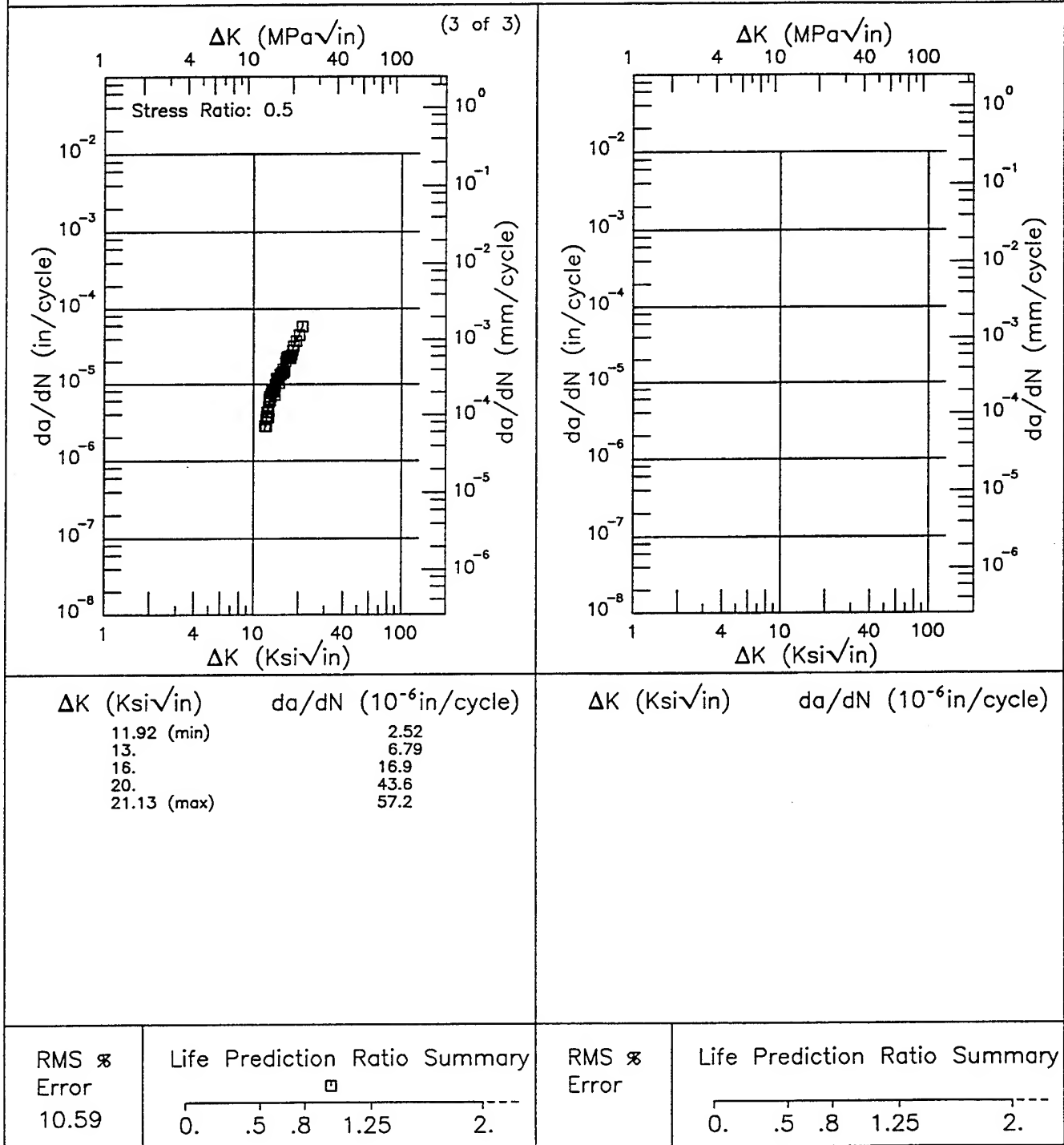


Figure 6.14.3.1.3 (Concluded)

F | Ti-6-2-4-2 ELI |

Condition/Ht: ANNEAL 1450F 1HR AC  
 Form: 0.75 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Stress Ratio: 0.02  
 Environment: LAB AIR;1000°F

Yield Strength: 78 ksi  
 Ult. Strength: 96 ksi  
 Specimen Thk: 0.187 in.  
 Specimen Width: 3 - 3.002 in.  
 Ref: MA016

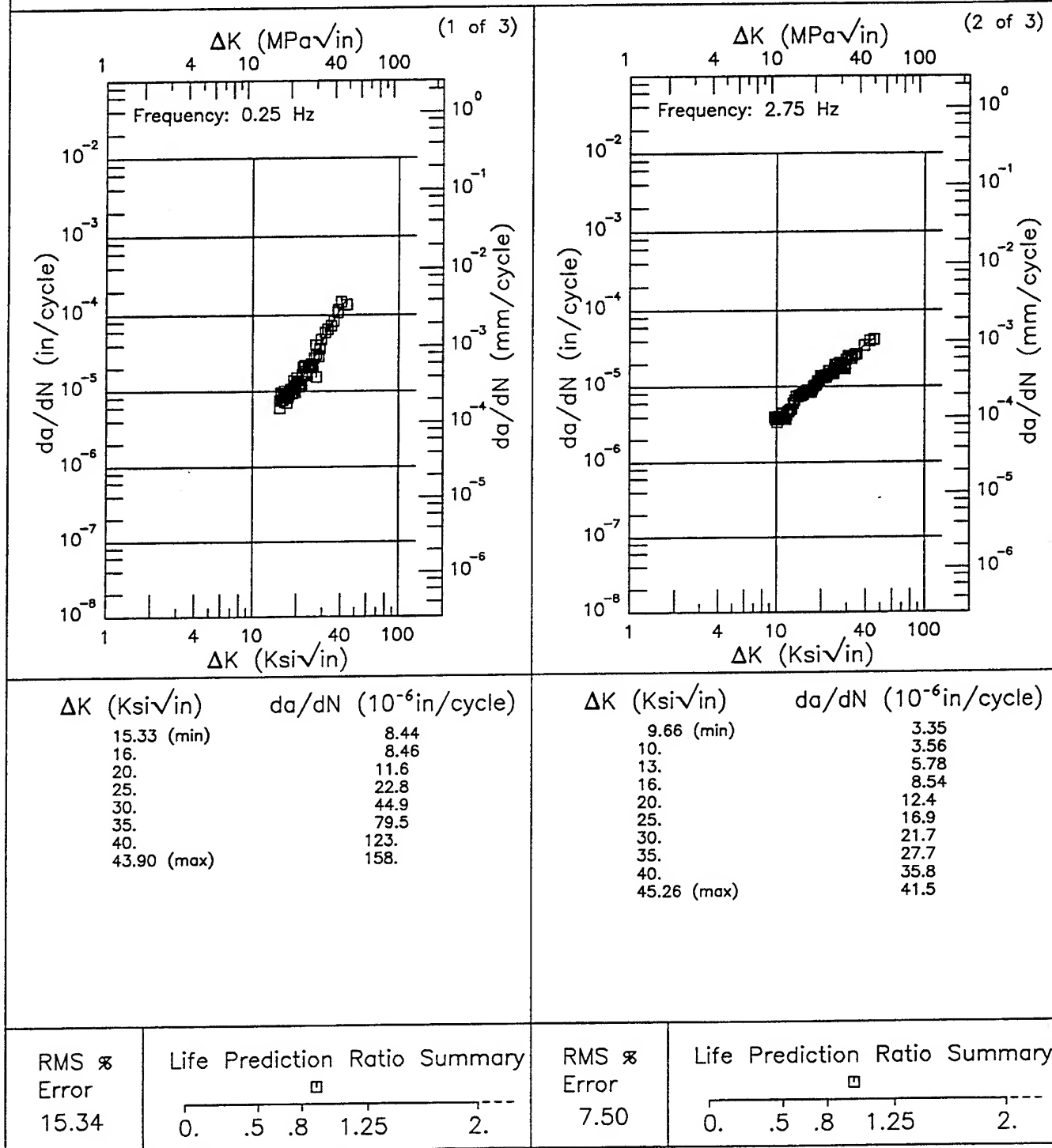


Figure 6.14.3.1.4

Condition/Ht: ANNEAL 1450F 1HR AC  
 Form: 0.75 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Stress Ratio: 0.02  
 Environment: LAB AIR;1000°F

Yield Strength: 78 ksi  
 Ult. Strength: 96 ksi  
 Specimen Thk: 0.187 in.  
 Specimen Width: 3 - 3.002 in.  
 Ref: MA016

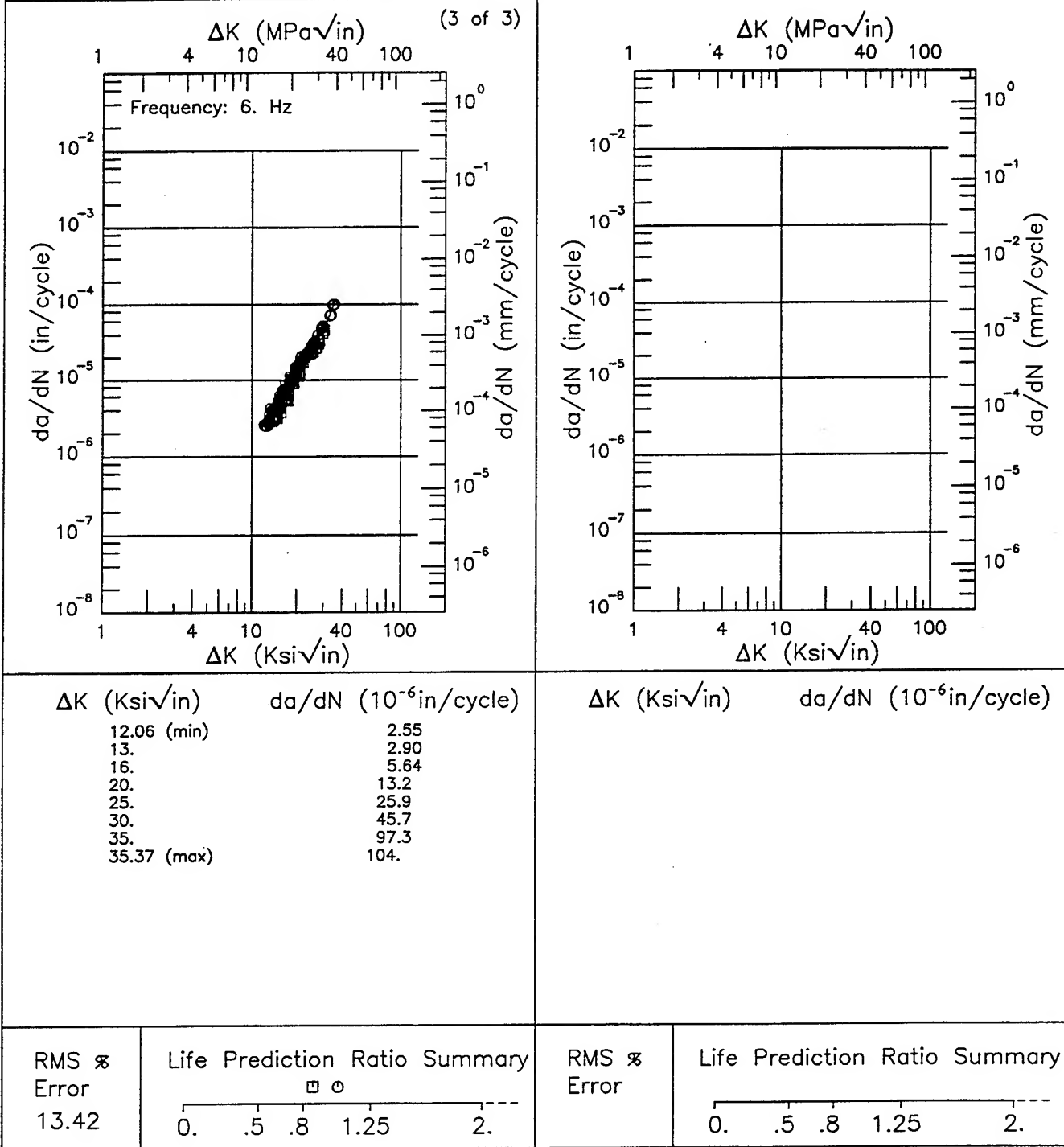


Figure 6.14.3.1.4 (Concluded)



EF | Ti-6-2-4-2 ELI |  
 Condition/Ht: ANNEAL 1450F 1HR AC  
 Form: 0.75 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Stress Ratio: 0.02

Yield Strength: 95 ksi  
 Ult. Strength: 109 ksi  
 Specimen Thk: 0.187 in.  
 Specimen Width: 3.001 in.  
 Ref: MA016

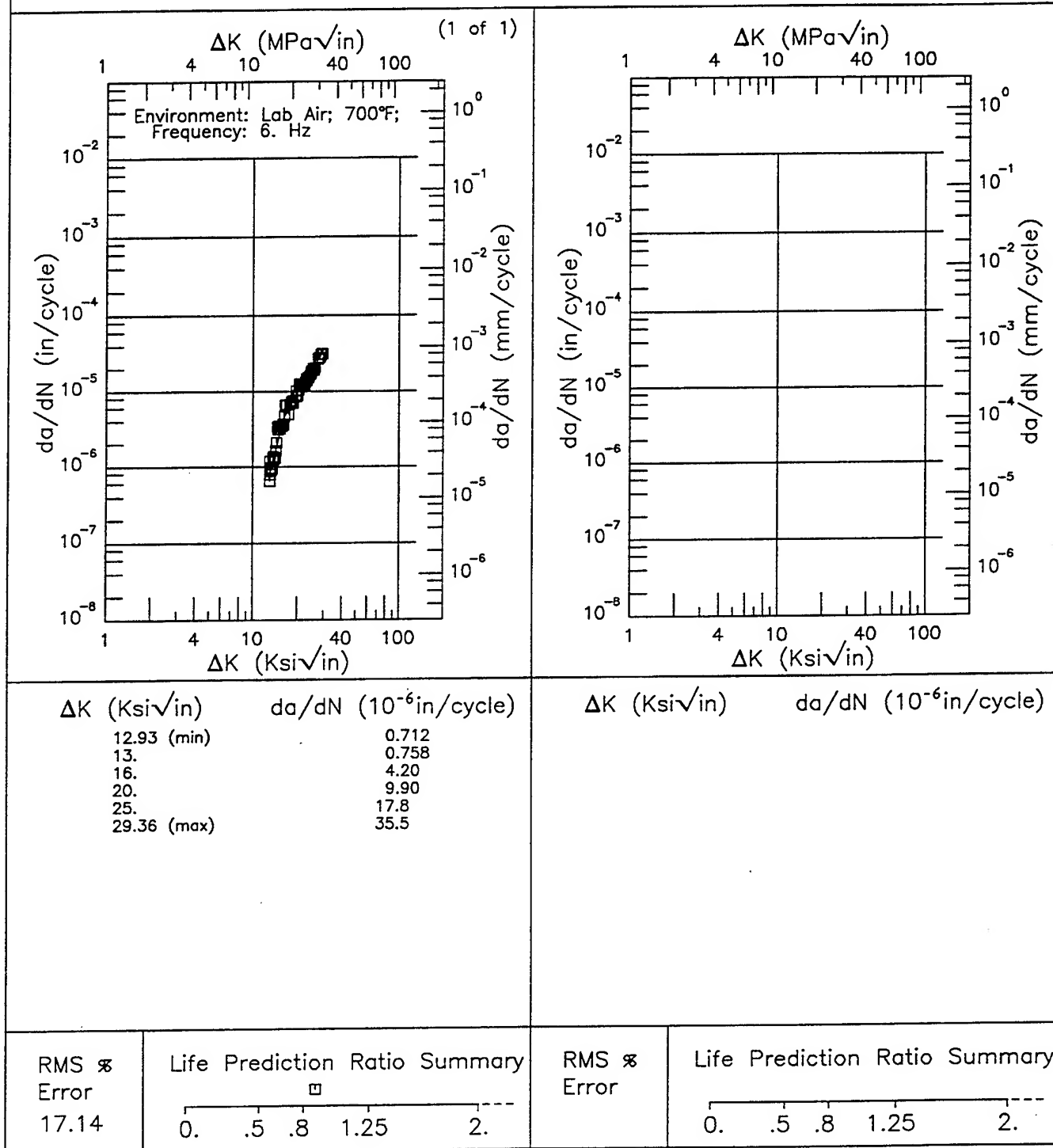


Figure 6.14.3.1.5

Condition/Ht: ANNEAL 1450F 1HR AC  
 Form: 0.75 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Stress Ratio: 0.5

Yield Strength: 78 ksi  
 Ult. Strength: 96 ksi  
 Specimen Thk: 0.187 in.  
 Specimen Width: 3 in.  
 Ref: MA016

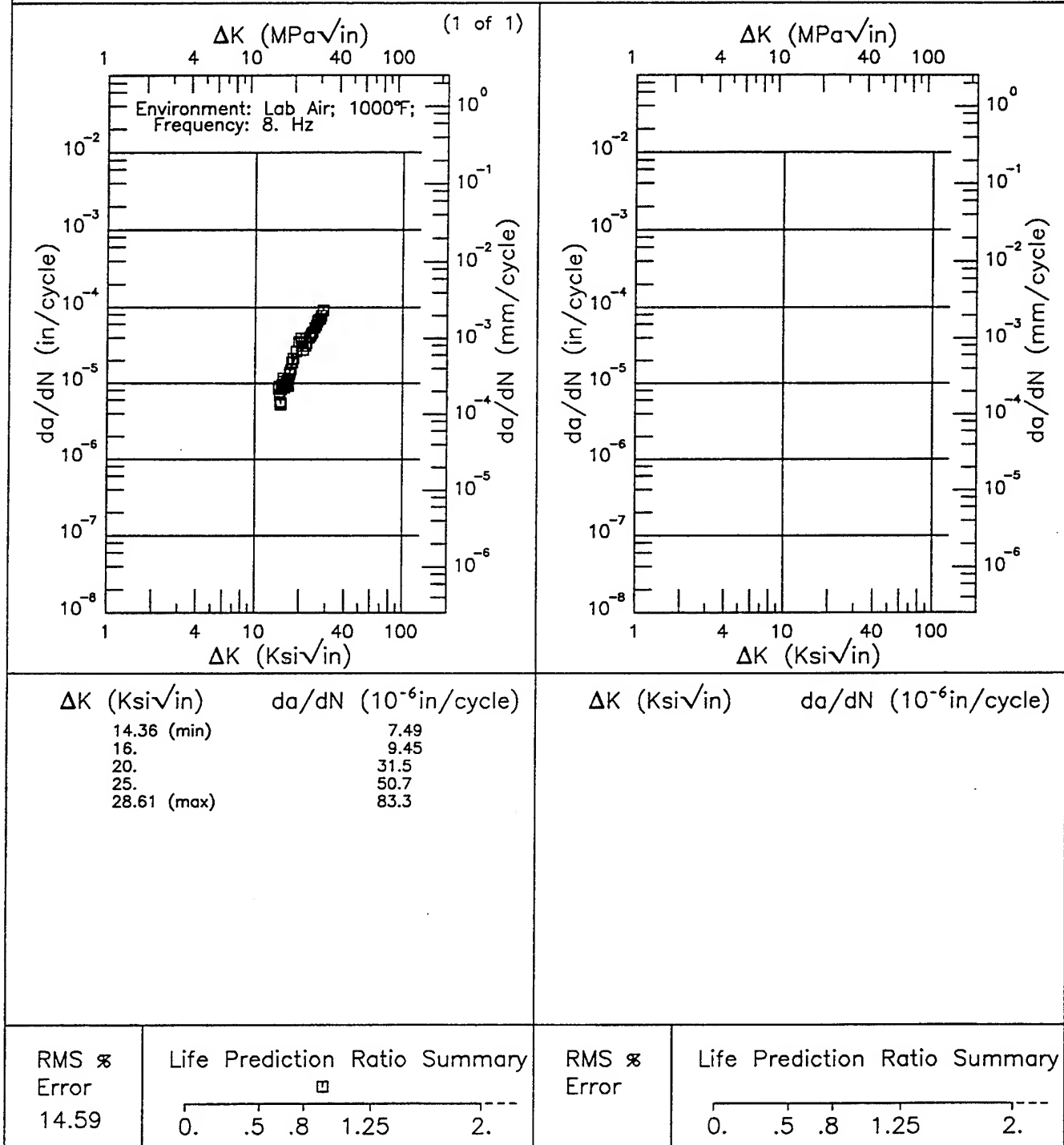


Figure 6.14.3.1.6

TABLE 6.15.1.2.1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-6-2-4-6 AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)				
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )				
				2.5	5.0	10.0	20.0	50.0
UNSPECIFIED	EXTRUSION	0.1	20			0.82	9.45	
								100.0

1 of 1

TABLE 6.15.1.2.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-6-2-4-6 AT ROOM TEMPERATURE**

ORIENTATION: C-R

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
1690F 2HRS AC 1650F 2HRS OQ 1100F 8HRS AC	FORGING	0.1	30		0.1	1.01			
		0.7	0.16	0.06	0.55				

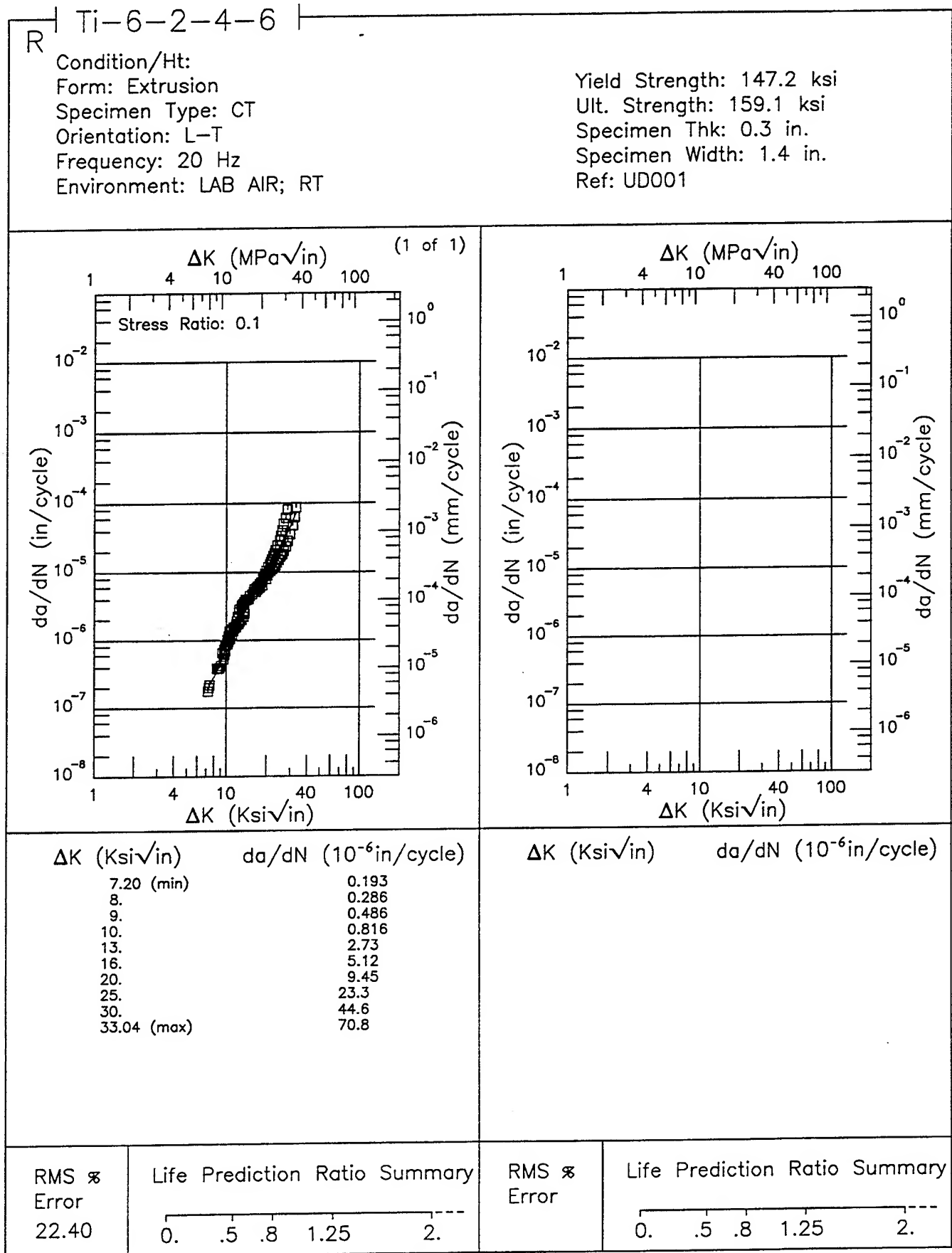


Figure 6.15.3.1.1

**This page intentionally left blank**

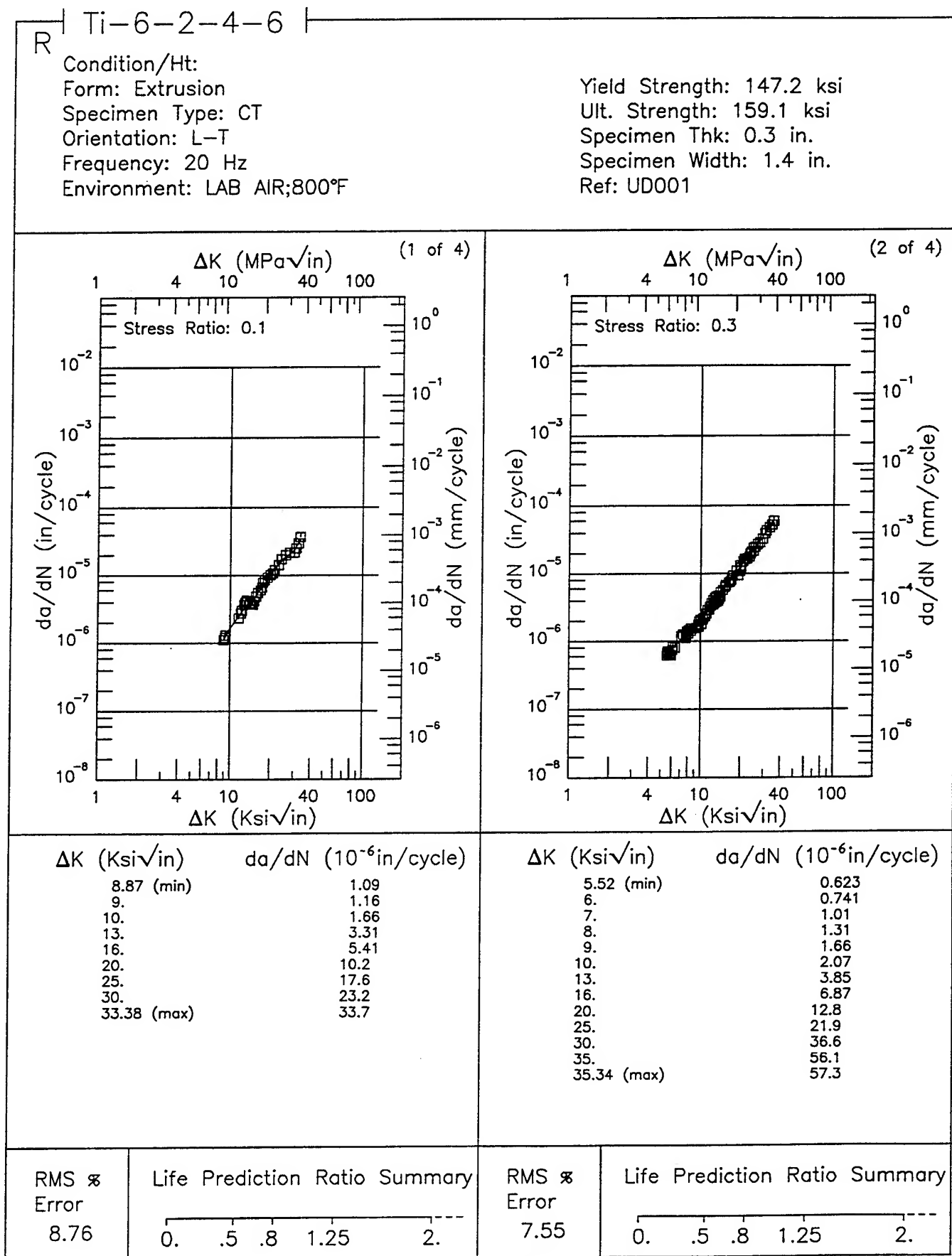
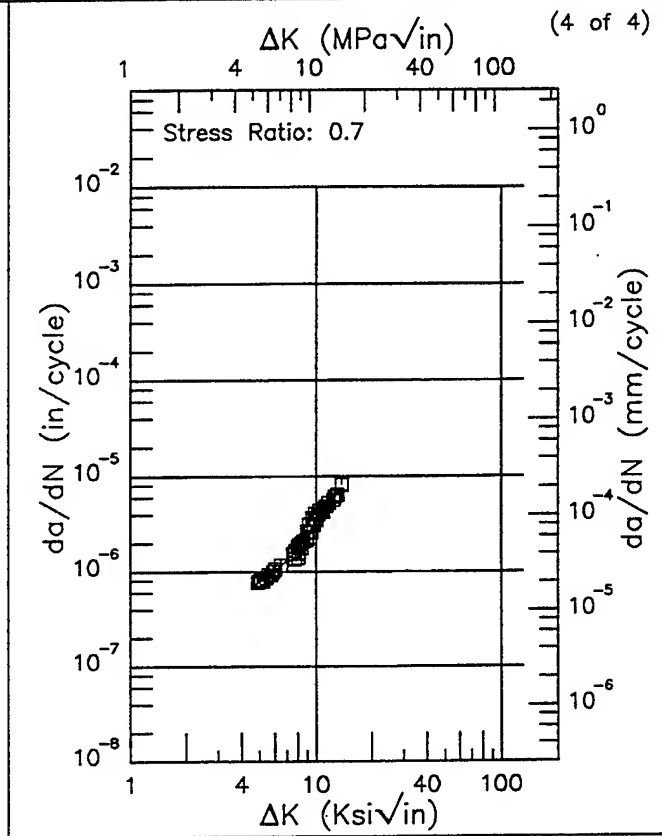
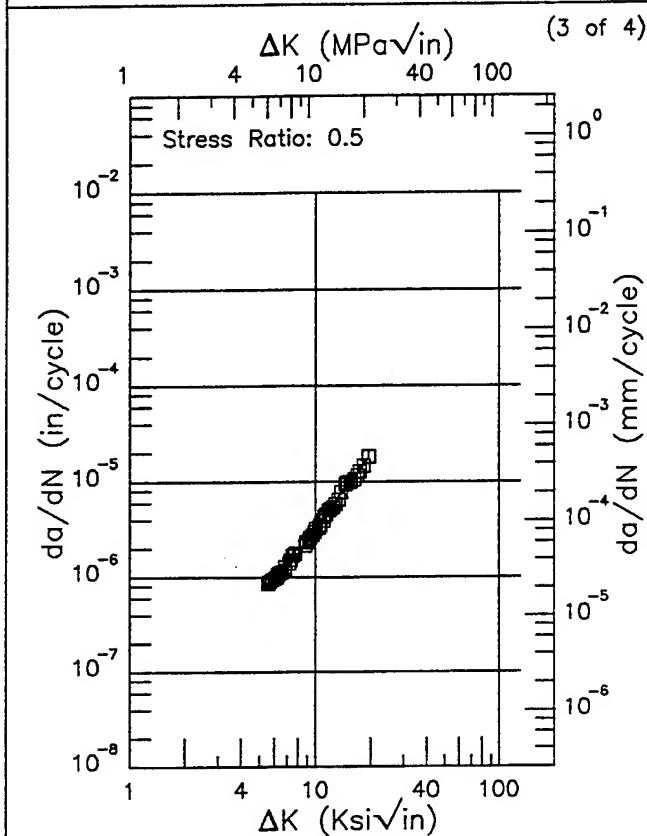


Figure 6.15.3.1.2

Condition/Ht:  
Form: Extrusion  
Specimen Type: CT  
Orientation: L-T  
Frequency: 20 Hz  
Environment: LAB AIR;800°F

Yield Strength: 147.2 ksi  
Ult. Strength: 159.1 ksi  
Specimen Thk: 0.3 in.  
Specimen Width: 1.4 in.  
Ref: UD001



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
5.54 (min)	0.814
6.	0.976
7.	1.35
8.	1.78
9.	2.31
10.	3.01
13.	6.52
16.	10.7
19.33 (max)	17.8

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
4.89 (min)	0.784
5.	0.798
6.	0.995
7.	1.32
8.	1.80
9.	2.48
10.	3.42
13.	6.74
13.67 (max)	7.16

RMS %  
Error  
4.18

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
9.87

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.15.3.1.2 (Concluded)



R

Ti-6-2-4-6

Condition/Ht: 1690F 2HRS AC 1550F 2HRS OQ 1100F 8HRS AC

Form: 1.8 - 2.8 in. Forging

Specimen Type: CCP (max load specified)

Orientation: C-R

Frequency: 30 Hz

Environment: LAB AIR; 800°F

Yield Strength: 165.5 - 166 ksi

Ult. Strength: 180.8 - 182.3 ksi

Specimen Thk: 0.077 - 0.082 in.

Specimen Width: 1.75 in.

Ref: PW002

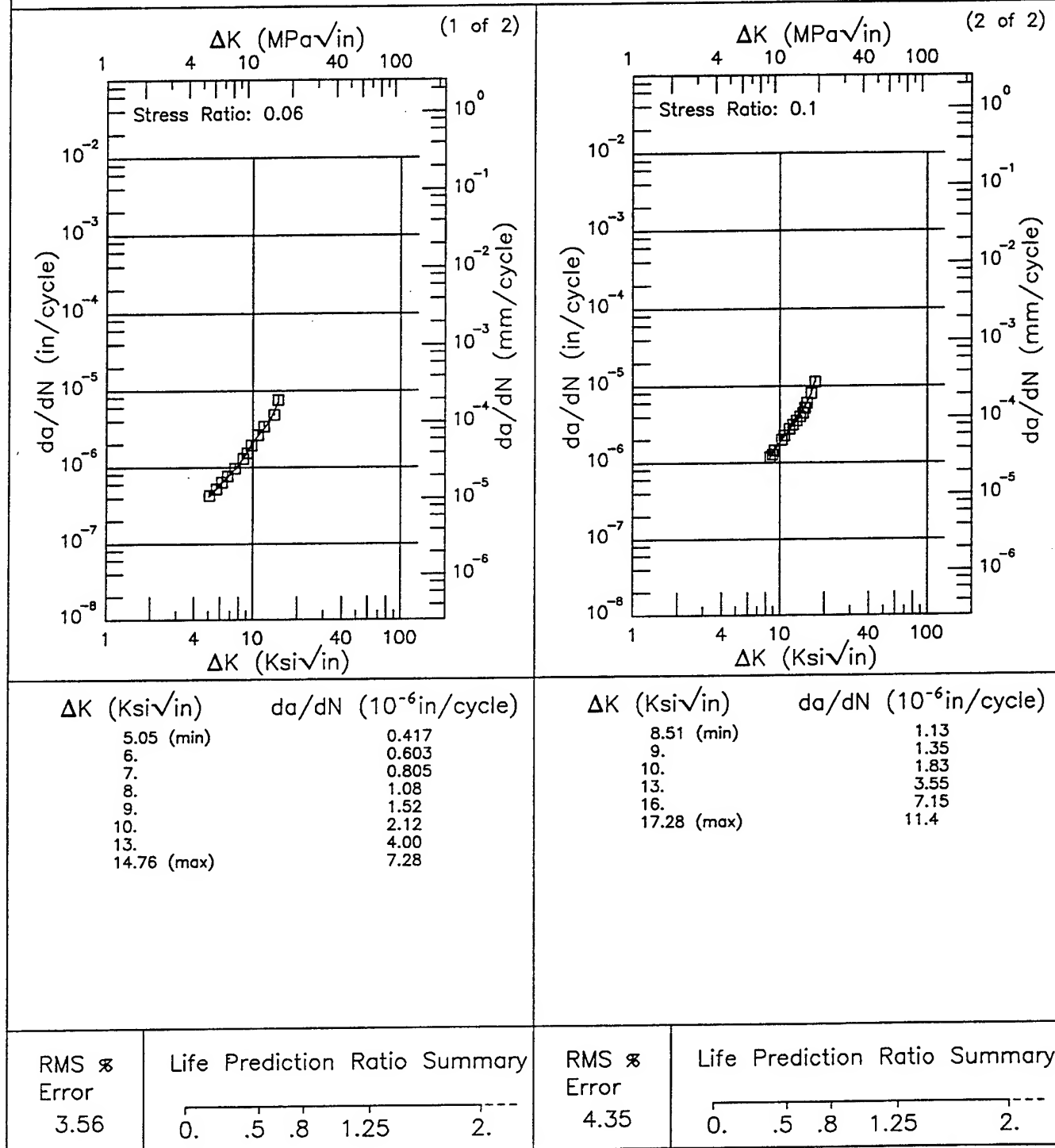


Figure 6.15.3.1.3

**This page intentionally left blank**

R

Ti-6-2-4-6

Condition/Ht: 1690F 2HRS AC 1550F 2HRS OQ 1100F 8HRS AC

Form: 1.8 - 2.8 in. Forging

Specimen Type: CCP (max load specified)

Orientation: C-R

Frequency: 0.2 Hz

Environment: LAB AIR;800°F

Yield Strength: 165.5 - 166 ksi

Ult. Strength: 180.8 - 182.3 ksi

Specimen Thk: 0.079 - 0.083 in.

Specimen Width: 1.75 in.

Ref: PW002

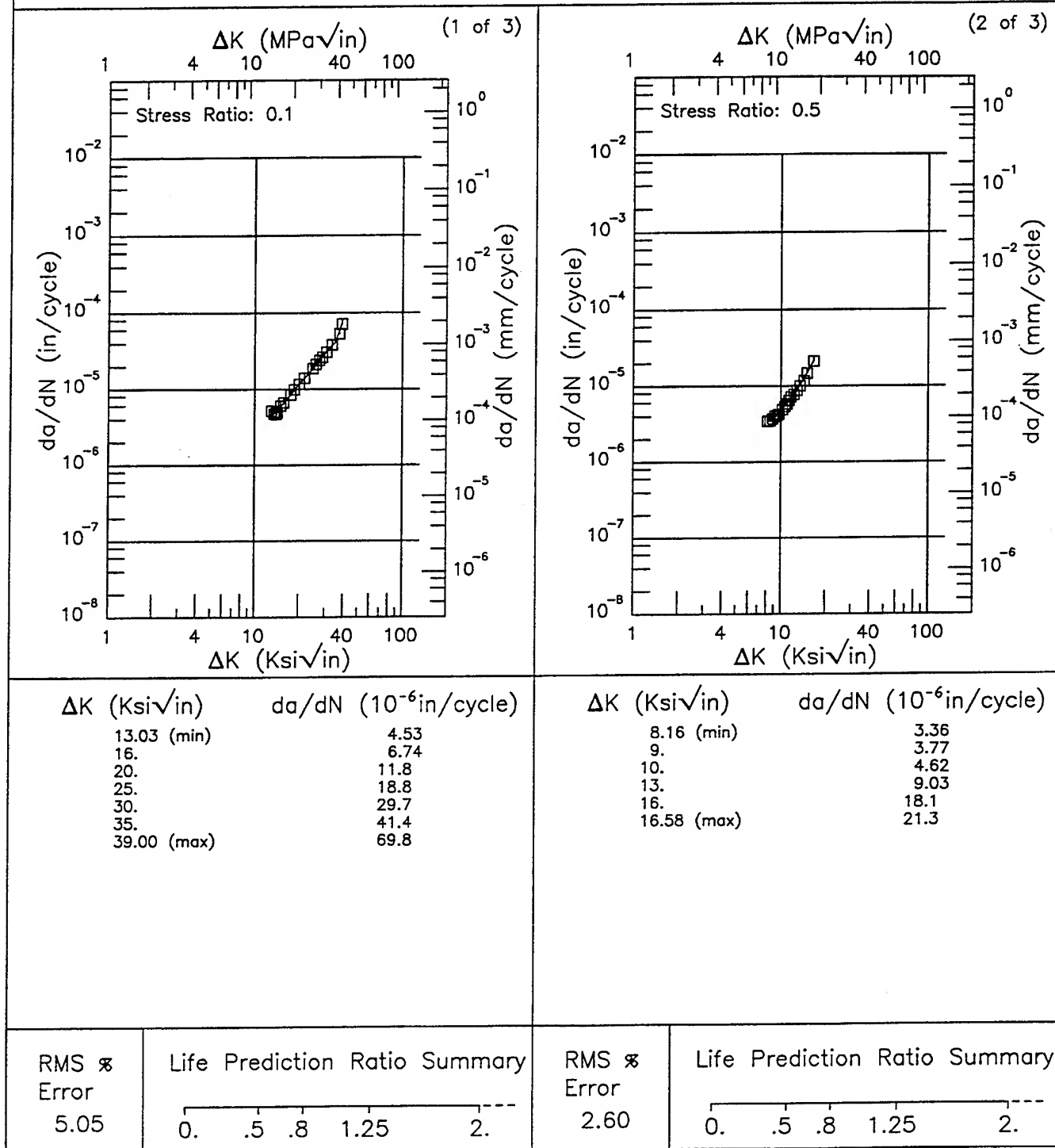


Figure 6.15.3.1.4

Condition/Ht: 1690F 2HRS AC 1550F 2HRS OQ 1100F 8HRS AC

Form: 1.8 - 2.8 in. Forging

Specimen Type: CCP (max load specified)

Orientation: C-R

Frequency: 0.2 Hz

Environment: LAB AIR;800°F

Yield Strength: 165.5 - 166 ksi

Ult. Strength: 180.8 - 182.3 ksi

Specimen Thk: 0.079 - 0.083 in.

Specimen Width: 1.75 in.

Ref: PW002

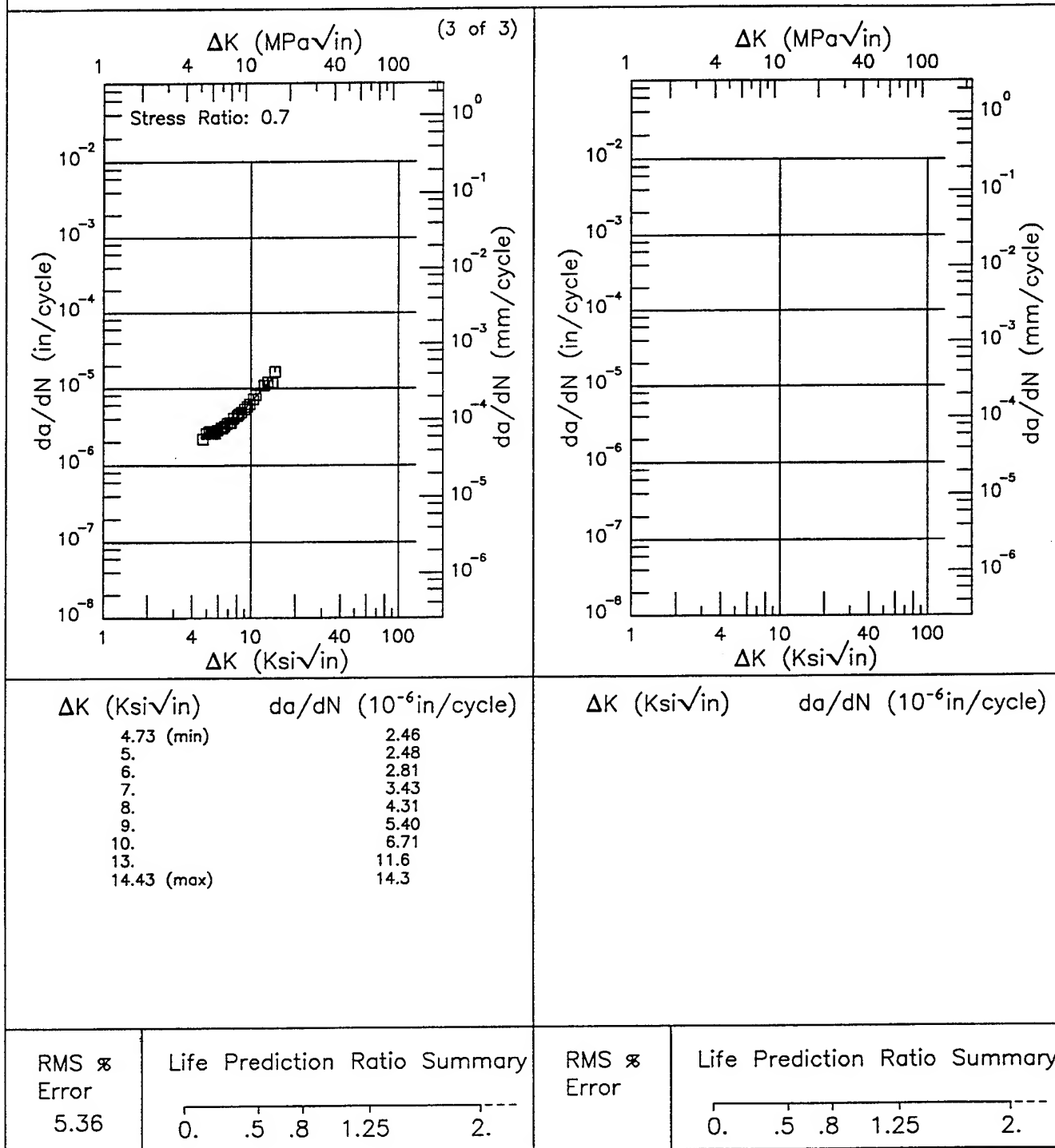


Figure 6.15.3.1.4 (Concluded)

R

Ti-6-2-4-6

Condition/Ht: 1690F 2HRS AC 1550F 2HRS OQ 1100F 8HRS AC

Form: 2.8 in. Forging

Specimen Type: CCP (max load specified)

Orientation: C-R

Frequency: 0.2 Hz

Environment: LAB AIR;600°F

Yield Strength: 166 ksi

Ult. Strength: 182.3 ksi

Specimen Thk: 0.08 - 0.081 in.

Specimen Width: 1.75 in.

Ref: PW002

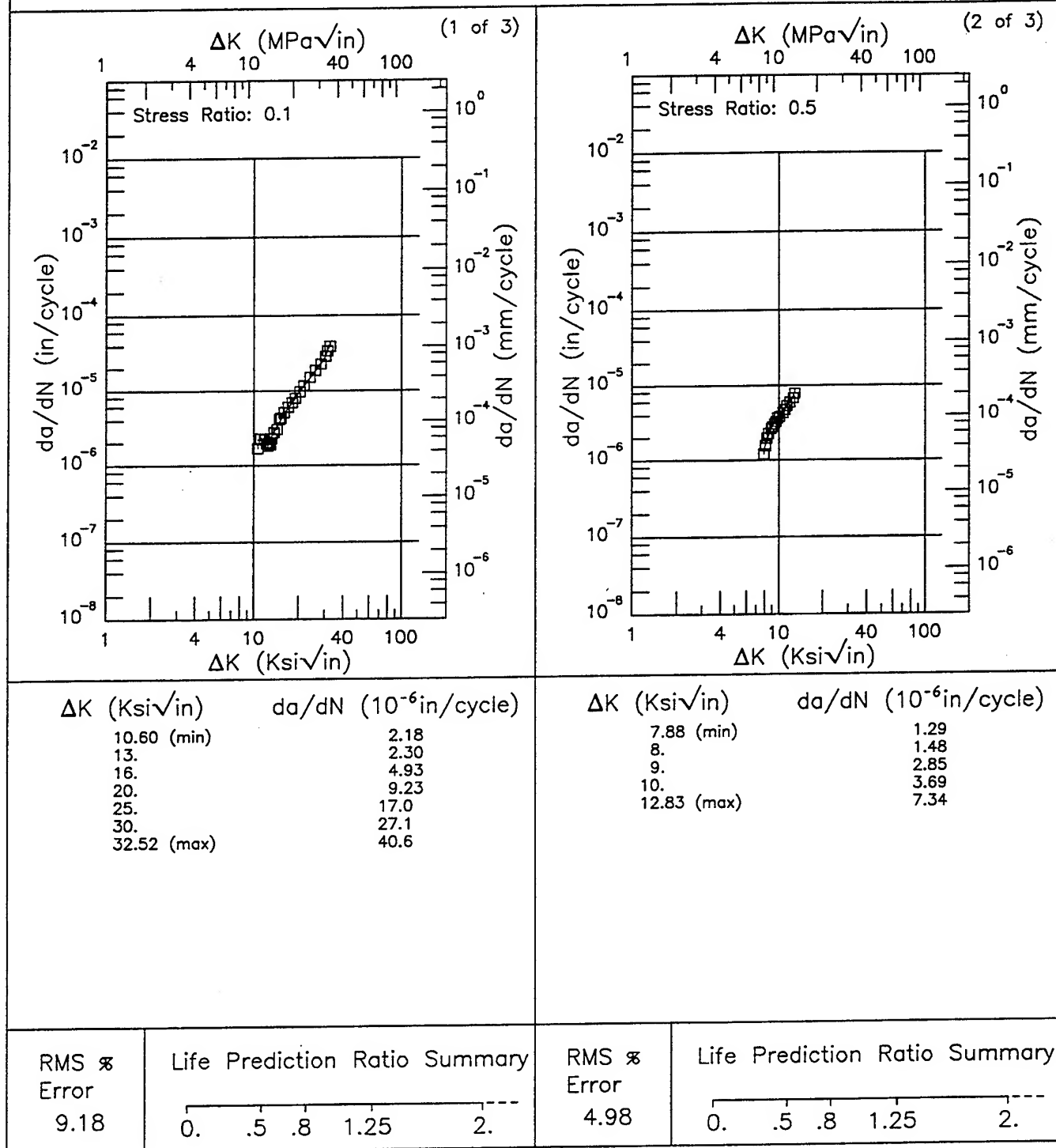


Figure 6.15.3.1.5

Condition/Ht: 1690F 2HRS AC 1550F 2HRS OQ 1100F 8HRS AC  
 Form: 2.8 in. Forging  
 Specimen Type: CCP (max load specified)  
 Orientation: C-R  
 Frequency: 0.2 Hz  
 Environment: LAB AIR;600°F

Yield Strength: 166 ksi  
 Ult. Strength: 182.3 ksi  
 Specimen Thk: 0.08 - 0.081 in.  
 Specimen Width: 1.75 in.  
 Ref: PW002

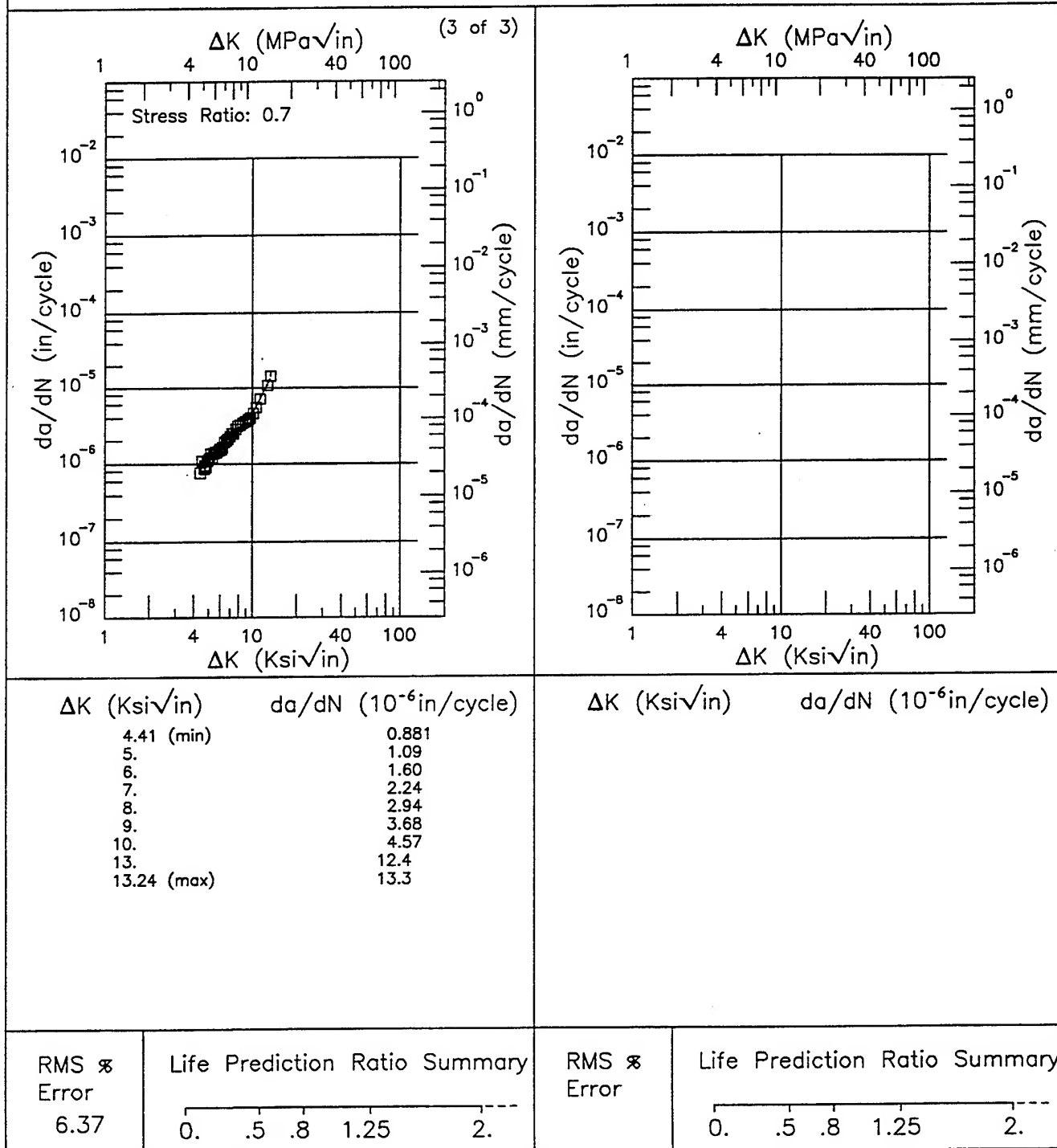


Figure 6.15.3.1.5 (Concluded)

R

Ti-6-2-4-6

Condition/Ht: 1690F 2HRS AC 1550F 2HRS OQ 1100F 8HRS AC

Form: 1.8 in. Forging

Specimen Type: CCP (max load specified)

Orientation: C-R

Frequency:

Environment: LAB AIR;600°F

Yield Strength: 165.5 ksi

Ult. Strength: 180.8 ksi

Specimen Thk: 0.074 in.

Specimen Width: 1.75 in.

Ref: PW002

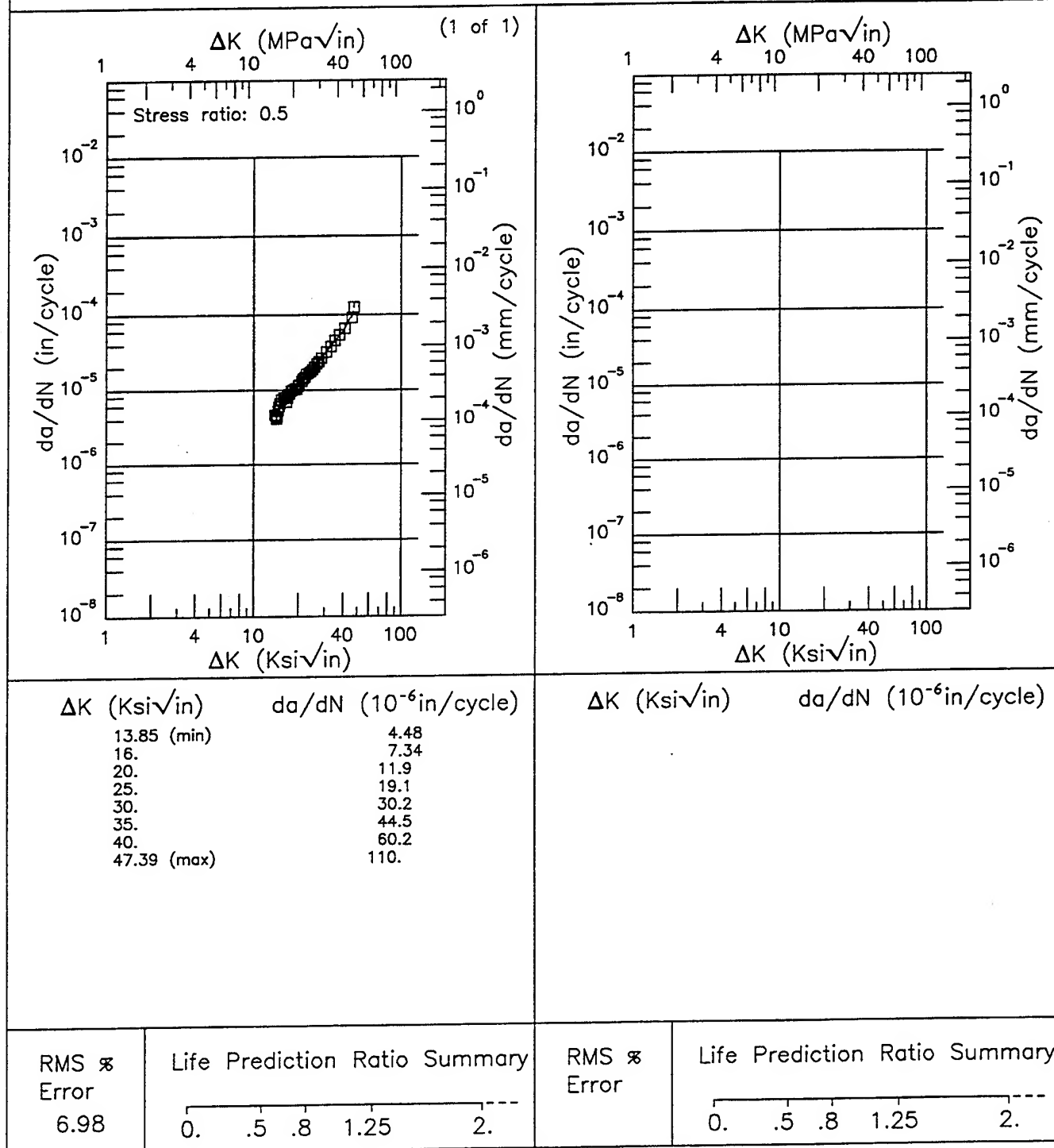


Figure 6.15.3.1.6

Condition/Ht: 1690F 2HRS AC 1550F 2HRS OQ 1100F 8HRS AC  
 Form: 2.8 in. Forging  
 Specimen Type: CCP (max load specified)  
 Orientation: C-R  
 Frequency: 0.2 Hz  
 Environment: LAB AIR; RT

Yield Strength: 166 ksi  
 Ult. Strength: 182.3 ksi  
 Specimen Thk: 0.079 - 0.08 in.  
 Specimen Width: 1.75 in.  
 Ref: PW002

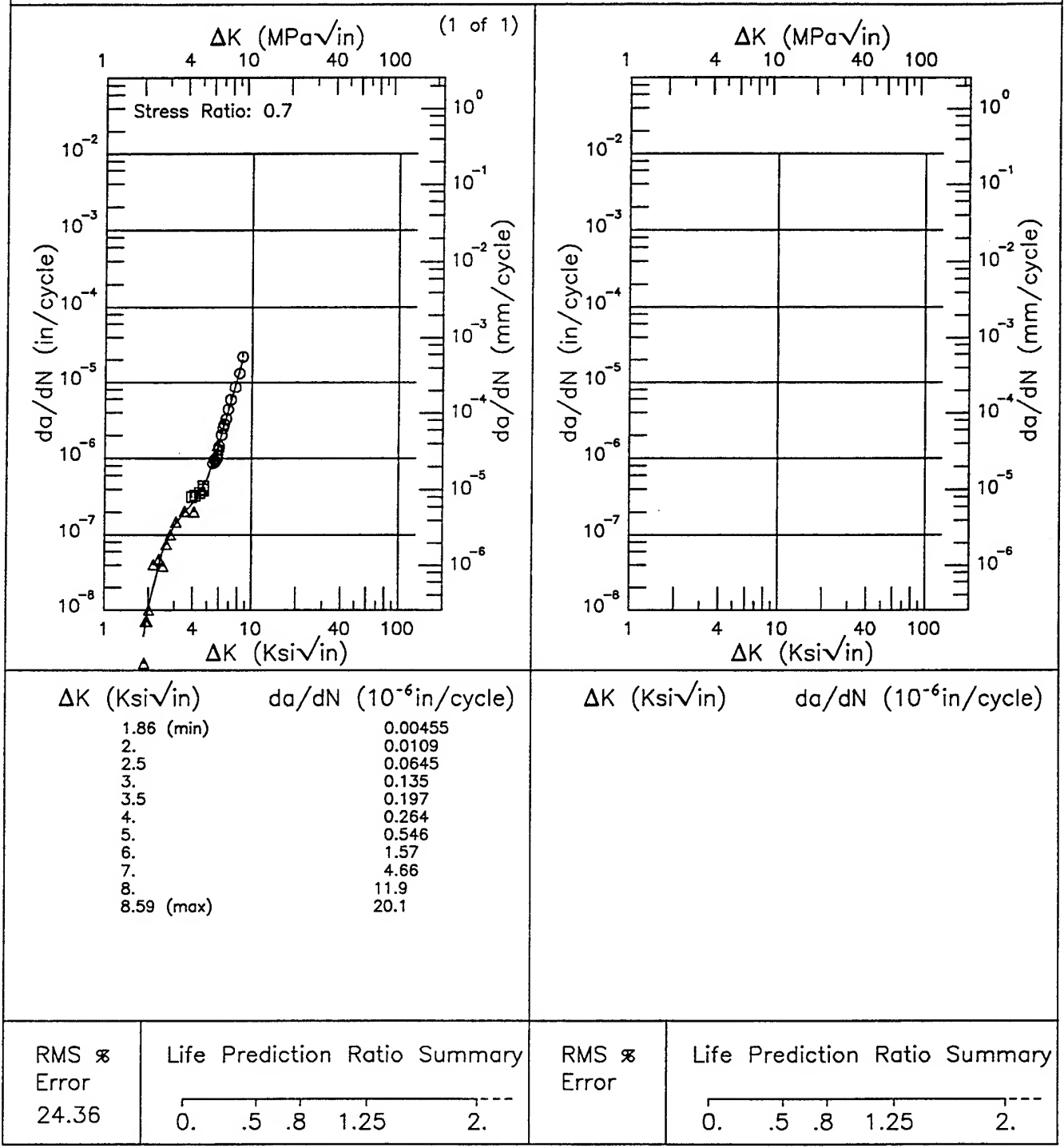


Figure 6.15.3.1.7  
 6-167



E | Ti-6-2-4-6 |

Condition/Ht: 1690F 2HRS AC 1550F 2HRS OQ 1100F 8HRS AC

Form: 2.8 in. Forging

Specimen Type: CCP (max load specified)

Orientation: C-R

Stress Ratio: 0.1

Frequency: 30 Hz

Yield Strength: 166 ksi

Ult. Strength: 182.3 ksi

Specimen Thk: 0.078 - 0.081 in.

Specimen Width: 1.75 in.

Ref: PW002

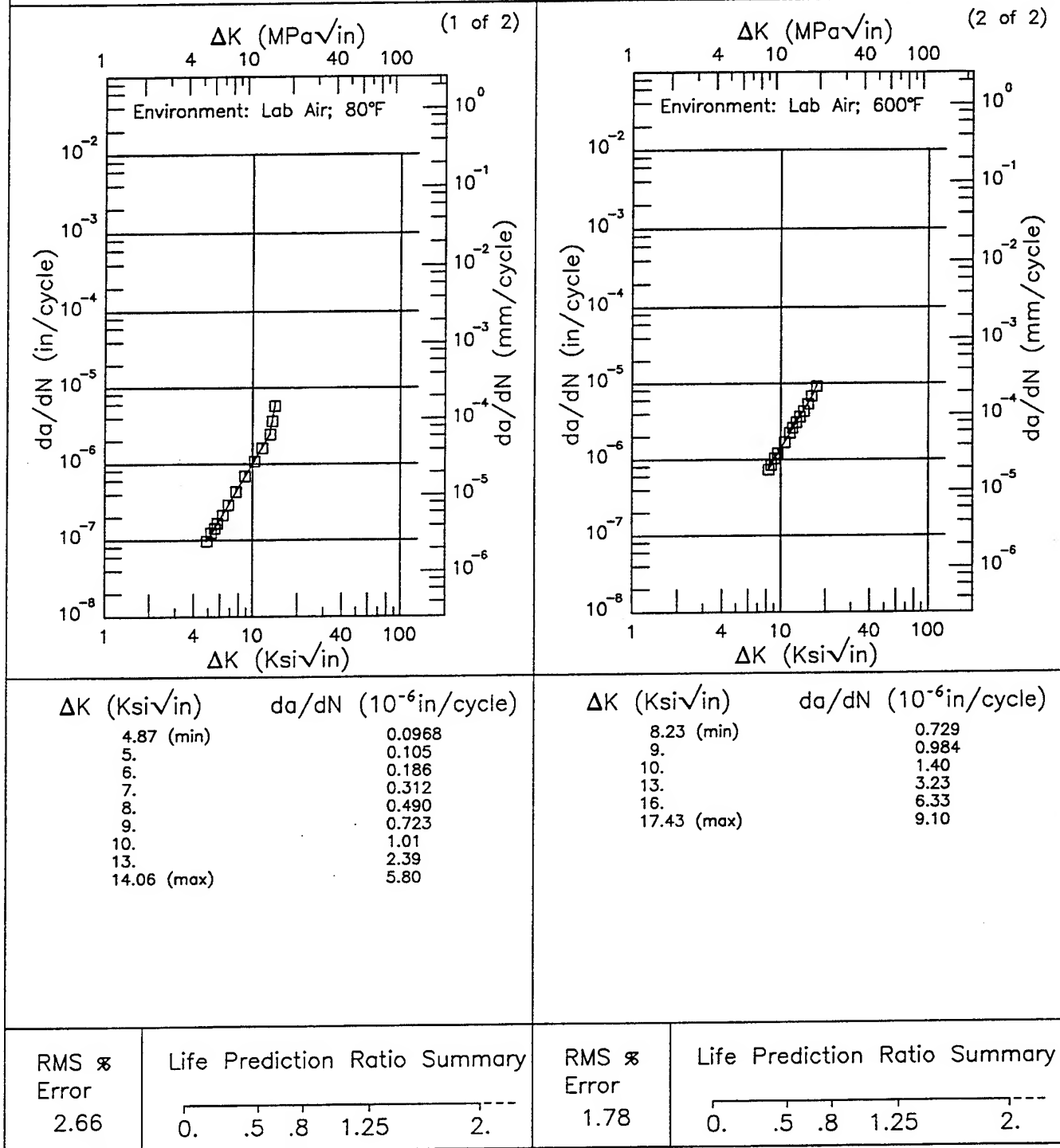


Figure 6.15.3.1.8

TABLE 6.16.1.1

1 of 2

**MEAN PLANE STRAIN FRACTURE TOUGHNESS  
FOR TITANIUM ALLOY Ti-6Al-4V AT ROOM TEMPERATURE**

Product Form	Condition/Heat Treatment	$K_{Ic}$ ( $ksi\sqrt{in}$ )									
		Specimen Orientation									
		L-T		T-L			S-L				
		Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	
Plate	1750F 1HR FC TO 1100F	---	---	---	91.5	2.1	2	---	---	---	
	1750F 1HR FC TO RT	71.8	3.2	2	91.6	1.3	2	---	---	---	
	1750F 2HR WQ 1000F 2HR AC 1300F 2HR AC STA	41.4	2.3	2	---	---	---	---	---	---	
	ANNEALED 1375F 3HR AC	60.4	5.5	2	---	---	---	---	---	---	
	BETA PROCESSED - MA	94.9	4.8	3	---	---	---	---	---	---	
	MA	74.4	32.6	3	91.6	24.4	7	---	---	---	
	RA	82.8	7.8	22	80.8	10.8	22	---	---	---	
	STA	---	---	---	42.6	2.	3	---	---	---	
	1700F 6HR AC 1400F 6HR AC	75.9	4.2	6	81.2	5.8	6	---	---	---	
	1750F 1HR WQ 1000F 4HR	---	---	---	79.3	4.9	3	---	---	---	
Forging	AB FORGED-MA ALPHA-BETA FORGED MA	---	---	---	35.4	2.7	4	---	---	---	
	ANNEALED	70.8	15.9	4	67.3	13.6	6	---	---	---	
	ANNEALED 1300F 4HR AC	58.1	1.2	3	62.2	3.	3	68.1	1.	2	

**TABLE 6.16.1.1 (CONCLUDED)**  
**MEAN PLANE STRAIN FRACTURE TOUGHNESS**  
**FOR TITANIUM ALLOY Ti-6Al-4V AT ROOM TEMPERATURE**

Product Form	Condition/Heat Treatment	$K_{Ic}$ (ksi $\sqrt{in}$ )									
		Specimen Orientation									
		L-T			T-L			S-L			
		Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	
Forging (Cont'd)	B FORGED-MA BETA FORGED MA 1300F 2HR AC	70.6	4.9	3	---	---	---	---	---	---	
	B FORGED-MA BETA FORGED MA 1300F 2HR AC	---	---	---	71.	0.4	3	73.9	2.5	2	
	MA 1300F 2HR AC	50.9	6.9	4	49.5	3.9	3	43.6	5.8	3	
	RA	83.6	5.5	41	83.9	6.9	50	88.9	3.2	9	
Extrusion	ANNEALED	82.6	5.3	5	85.2	6.5	6	---	---	---	
	MA	83.5	3.1	5	87.5	4.1	6	---	---	---	
	AS RECEIVED	57.1	10.4	14	54.9	10.8	21	---	---	---	
Forged Bar	B FORGED BETA FORGED REHEATED TO 1950F DRAWN TO SIZE	---	---	---	42.6	4.3	4	---	---	---	
	ANNEALED	79.6	9.6	2	---	---	---	---	---	---	
Billet	ANNEALED 1000F 2HR AC	50.9	0.6	2	---	---	---	---	---	---	
	DBA	68.2	9.7	9	64.2	11.8	13	---	---	---	
	MA 1300F 2HR AC	84.	3.4	3	---	---	---	---	---	---	

TABLE 6.16.1.2.1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: L-S

ENVIRONMENT: H.H.A.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
RA	PLATE	0.1	10			1.11	12.82		

TABLE 6.16.1.2.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Distilled Water

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $K\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED	FORGING	0.1	1			0.37	14.31		
	EXTRUSION	0.1	1			0.39	7.49		
		0.8	1		0.22	1.37			

TABLE 6.16.1.2.3

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Dry Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
BA	PLATE	0.1	6			0.16	8.39	111.47	
		0.3	6			0.29	10.1		
		0.5	6			1.16	11.38		
BETA PROCESSED - MA	SHEET	0.1	10					52.48	
	PLATE	0.1	10				4.72	42.1	
		0.08	1				16.7	757.11	
DBTC	PLATE	0.3	1			0.6	18.69		
		0.3	1				12.85	281.01	
		0.08	1-6			1.67	13.5		
MA	SHEET	0.3	6			2.27			
		0.5	6			2.3	21.08		
		0.3	1				69.42		
	PLATE	0.3	1				21.66		
		0.3	1-6			0.43	16.1	361.47	
		0.08	6				11.99		
	EXTRUSION								

Ti-6Al-4V

TABLE 6.16.1.2.3 (CONCLUDED)

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Dry Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/in)					
				2.5	5.0	10.0	20.0	50.0	100.0
MA	EXTRUSION	0.08	6			0.34	12.64		
		0.3	6				16.36		
		0.5	6				16.88		
RA	PLATE	0.08	6			0.44	10.09	204.33	
		0.3	6			1.46	13.34		
		0.5	6			2.16	18.1		
		0.7	6			3.21			
	FORGING	0.08	1			0.39	5.83	172.77	
		0.08	6				6.58		
		0.3	6			1.16	15.47	338.75	

TABLE 6.16.1.2.4

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: H.H.A.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
BA	PLATE	0.1	0.1				3.75	111.63	
		0.3	0.1				9.28		
		0.5	0.1				11.75	999.86	



TABLE 6.16.1.2.5

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: JP4

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)				
				$\Delta K$ Level (Ksi/in)				
				2.5	5.0	10.0	20.0	50.0
BA	FORGING	0.02	0.1-20				2.11	91.55
MA	SHEET	0.08	6			1.58	13.92	
RA	PLATE	0.08	1			0.64	12.39	
	FORGING	0.08	1				4.95	

TABLE 6.16.1.2.6

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	$FCGR (10^{-6} \text{ in/cycle})$					
				$\Delta K \text{ Level (Ksi}\sqrt{\text{in}})$					
				2.5	5.0	10.0	20.0	50.0	100.0
ALPHA-BETA FORGE-ANNEALED	FORGING	0.1	30			1.02			
		0.1	30		0.05				
		0.1	30		0.05				
ANNEALED	FORGING	-1	5			0.87	10.33		
		0.1	5			0.29	9.53		
		0.1	15				11.12		
		0.1	20			0.38			
		0.4	10		0.05	1.32	16.33		
		0.4	20		0.02	1.09	17.6		
	EXTRUSION	0.8	15		0.07				
		-1	5			0.41	7.29		
		0.1	8			0.34	11.63		
		0.1	15				8.68	242.97	
		0.1	20			0.18			
		0.4	15		0.03	0.57	16.54		

TABLE 6.16.1.2.6 (CONTINUED)

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED	EXTRUSION	0.8	10		0.13	1.08			
		0.8	15		0.1	1.37			
		0.8	30		0.08	1			
ANNEALED AT 1375F 3HRS AC BA	BILLET	0.02	10-20			0.27	11.05		
	PLATE	0.02	10-20			0.25	11.03		
	FORGING	0.02	0.1-20				2.55	105.12	
BETA PROCESSED - MA	PLATE	0.1	1				0.87		
		0.5	1			1.84			
		-1	10			1.14	12.91	322.86	
MA	PLATE	0.02	0.1-20			0.32	10.8		
		0.02	1-27			0.11			
		0.02	0.1-30			0.15	6.77		
		0.02	5-30		0.02	0.4	15.79		
		0.04	20					93.19	
		0.05	20				6.34		

TABLE 6.16.1.2.6 (CONCLUDED)

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
MA	PLATE	0.3	20			0.99			
		0.5	10			8.61	97.18		
	FORGING	0.02	1-30				8.18	292.11	
		0.1	10			4.64			
	EXTRUSION	0.1	1-10				9.35	189.23	
		0.1	1-20				12.2	225.55	
		0.3	10			8.82			
	UNSPECIFIED	0.55	10		0.84				

TABLE 6.16.1.2.7

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: S.S.W.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)				
				$\Delta K$ Level (Ksi $\sqrt{in}$ )				
				2.5	5.0	10.0	20.0	50.0
BA	FORGING	0.02	0.1-20				4.83	154.25
MA	EXTRUSION	0.1	1-10				11.38	270.5

TABLE 6.16.1.2.8

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: S.T.W.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
BA	PLATE	0.1	1				11.02	160.87	
DBTC	PLATE	0.08	1			0.69	13.62		
MA	SHEET	0.08	1			3.24			
	PLATE	0.3	1				75.32		
		0.3	1			0.63	34.25		
RA	EXTRUSION	0.1	1-10				10.89	210.05	
		0.08	0.1-1			0.71	12.91		
		0.08	1			1.19	22.42	264.77	
	PLATE	0.08	1			0.37	8.03		
		0.3	1			2.2	24.11		
FORGING		0.5	1			4.18			
		0.08	1			1.58	38.76		



TABLE 6.16.1.2.9

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: T-S				ENVIRONMENT: 3.5% NaCl						
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)						
				$\Delta K$ Level (Ksi $\sqrt{in}$ )						
				2.5	5.0	10.0	20.0	50.0	100.0	
BA	PLATE	0.1	10			0.62	18.38			
RA	PLATE	0.1	10				49.71			

TABLE 6.16.1.2.10

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

**ORIENTATION: T-L**      **ENVIRONMENT: 3.5% NaCl**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
BA	PLATE	0.1	1				37.41	255.71	
		0.1	10			0.79	13.63	102.98	
		0.	15			0.63			
		0.1	0.1			3.5	44.65		
		0.1	0.1						
RA	PLATE	0.1	10			4.91	61.29		
		0.1	10				57.53		
		0.5	0.1			2.03			
		0.5	1			2.67	114.91		
		0.5	10			34.23	170.88		
RA(FAST COOLED)	PLATE	0.1	1				29.74		
STRESS RELIEVED E.B. WELDMENT (HAZ)	WELDMENT	0.1	10				9.28		
STRESS RELIEVED E.B. WELDMENT (WELD ZONE)	WELDMENT	0.1	0.1						



TABLE 6.16.1.2.11

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

**ORIENTATION: T-L                      ENVIRONMENT: ALT JP4/H<sub>2</sub>O (D)**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
RA	PLATE	0.5	1			1.68	37.77		

TABLE 6.16.1.2.12

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: Distilled Water

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED	FORGING	0.1	1		0.15	2.64	28.49		
		0.8	1		8.14	17.51			
	EXTRUSION	0.1	1				7.72		
		0.8	1		0.34	2.04			
BA	PLATE	0.1	0.1					123.05	
RA	PLATE	0.	15			0.43			
		0.1	0.1				22.52	270.27	
		0.5	0.1				21.8		
		0.5	1			2.77	28.03		
STRESS RELIEVED E.B. WELDMENT (WELD ZONE)	WELDMENT	0.1	0.1						
		0.1	10						

TABLE 6.16.1.2.13

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: Dry Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
DB	PLATE	0.08	6			0.33	12.47		
		0.3	6				34.69		
DBTC	PLATE	0.08	1				7.71	161.59	
		0.3	1			0.49	12.28	276.36	
MA	SHEET	0.08	6				9.53		
	EXTRUSION	0.08	6				12.12		
RA	PLATE	0.08	6			0.43	10.76		
		0.08	6			0.46	11.32	232.73	
		0.1	0.1					224.79	
		0.5	0.1			1.08	20.39		
		0.5	1				18.21		
		0.08	6				7.57	137.41	
	FORGING	0.5	6			2.62	19.72		

TABLE 6.16.1.2.14

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: F.C.S.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
RA	PLATE	0.08	1						

TABLE 6.16.1.2.15

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: H.H.A.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
RA	PLATE	0.1	10			3.86	22.11		
		0.1	10				14.61		
		0.5	10		0.34	3.66	65.81		
		0.6	10			6.41	26.62		

TABLE 6.16.1.2.16

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: JP4

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
BA	FORGING	0.02	0.1-20				2.09	97.77	
RA	PLATE	0.08	1			0.69	14.92		
STRESS RELIEVED E.B. WELDMENT (HAZ)	WELDMENT	0.1	0.1				14.55	621	
		0.1	10				9.36		



TABLE 6.16.1.2.17

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED	FORGING	0.1	5				13.11		
		0.1	20			0.65	12.14		
		0.4	10		0.1	2.41	18.6		
		0.4	20		0.05	1.41	17.34		
		0.8	15		0.23				
		0.8	30		0.25	6.32			
	EXTRUSION	0.1	5-10			0.34	7.95		
		0.1	15				5.84	161.87	
		0.1	20		0.01	0.2			
		0.4	5-15		0.06	0.84	14.05		
		0.4	15		0.03	0.4	13.39		
		0.8	30		0.08	0.87			
AS WELDED E.B. WELDMENT (HAZ)	WELDMENT	0.1	10				6.52		
AS WELDED E.B. WELDMENT (WELD ZONE)	WELDMENT	0.1	10				5.94		
BA	FORGING	0.02	0.1-20				1.93	94.89	

TABLE 6.16.1.2.17 (CONCLUDED)

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

**ORIENTATION: T-L**      **ENVIRONMENT: Lab Air**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	<i>FCGR (<math>10^{-6}</math> in/cycle)</i>					
				$\Delta K$ Level ( $Ksi/\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
MA	EXTRUSION	0.1	5-20				13.75	276.81	
RA	PLATE	0.1	10				23.53		
STRESS RELIEVED E.B. WELDMENT (HAZ)	WELDMENT	0.1	10				11.35	508.19	
STRESS RELIEVED E.B. WELDMENT (WELD ZONE)	WELDMENT	0.1	10				10.93		



TABLE 6.16.1.2.18

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-6AL-4V AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: S.S.W.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
BA	FORGING	0.02	0.1-20				3.76	126.14	
MA	EXTRUSION	0.1	1-10				17.18	209.03	

TABLE 6.16.1.2.19

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ENVIRONMENT: S.T.W.

ORIENTATION: T-L

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
BA	PLATE	0.1	0.1			0.58	6.43	400.25	
		0.1	1				36.67	185.25	
		0.1	10				20.7	98.95	
DB	PLATE	0.08	1				7.9	225.95	
DB + 2DBTC	PLATE	0.08	1				7.62	249.01	
DB + 4DBTC	PLATE	0.08	1				9.51	170.63	
DBT + PC	PLATE	0.08	1				11.08		
DBTC	PLATE	0.08	1			2.81	17.87		
MA	EXTRUSION	0.08	1			0.62	11.14		
		0.1	1-10				25.92	354.12	
		0.	15			0.65			
RA	PLATE	0.08	1			2.08	48.68		
		0.08	1			0.83	10.46	294.78	
		0.1	0.1					820.85	
		0.1	0.1						

Ti-6Al-4V

TABLE 6.16.1.2.19 (CONCLUDED)

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
 Ti-6Al-4V AT ROOM TEMPERATURE

ORIENTATION: T-L

ENVIRONMENT: S.T.W.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
RA	PLATE	0.5	1			2.01	51.26		
	FORGING	0.08	1			0.75	16.9	235.07	
		0.08	1			0.62	14.24	185.08	
		0.5	1			3.41	58.02		

1 of 1

TABLE 6.16.1.2.20

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: STW/JP4

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
DBTC	PLATE	0.08	1			0.45	4.92		

TABLE 6.16.1.2.21

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: WATER SAT JP4

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
RA	PLATE	0.1	0.1					215.68	
		0.5	0.1				17.23		
		0.5	1			1.55	19.08		

TABLE 6.16.1.2.22

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: S-T

ENVIRONMENT: Dry Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $K\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
DB + 2DBTC	PLATE	0.08	6				7.97		

TABLE 6.16.1.2.23

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: S-T

ENVIRONMENT: S.T.W.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $Ksi\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
DB	PLATE	0.08	1			0.72	19.87		
DB + TR	PLATE	0.08	1				9.96		



TABLE 6.16.1.2.24

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-6Al-4V AT ROOM TEMPERATURE**

ENVIRONMENT: Argon

ORIENTATION: R-C

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
1550F 4HRS FC 1000F 4HRS Argon COOLED	FORGING	0.1	10				4.31		
1750F 4HRS Argon COOLED	FORGING	0.1	10				4.38		
1950F 4HRS WQ 1000F 4HRS Argon COOLED	FORGING	0.1	10				2.52	147.7	



1 of 1

**ORIENTATION: C-R**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $K_{SI}/in$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
1750F 4HRS Argon COOLED	FORGING	0.1	10						
1950F 4HRS WQ 1000F 4HRS Argon COOLED	FORGING	0.1	10				6		
							9.63		

TABLE 6.16.1.2.26

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

ORIENTATION: C-R

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
1775F 1HR WQ 1675F 1HR WQ 1000F 4HR AC	DISK	0.05	0.33-10					162.45	
1775F 1HR WQ 1675F 1HR WQ 1000F-1200F 2-8HR AC	DISK	0.03	0.33			0.82	11.45		
		0.03	0.5				9.93		
		0.25	0.33				22.1		
		0.25	0.5				17.73		
		-1	0.16			1.14			
UNSPECIFIED	UNSPECIFIED	-0.5	0.16			1.21			
		0.1	20				10.35		
		0.3	20			1.66	16.26		
		0.5	20			1.82			
		0.7	20		0.15				

TABLE 6.16.1.2.27

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V AT ROOM TEMPERATURE**

**ORIENTATION: UNSPECIFIED****ENVIRONMENT: Lab Air**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
BA	SHEET	0.1	10			1.84	14.44	122.21	
		0.1	10			4.66			
		0.3	10				14.91	210.93	
		0.7	10			3.87	26.35		
HIP 1650F 15 KSI	CASTING	0.1	0.1-20						
UNSPECIFIED	UNSPECIFIED	0.1	30			1.33			

TABLE 6.16.2.1

TITANIUM Ti-6Al-4V $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (ksi)	SPECIMEN			CRACK LENGTH (in.) A	$\Delta K_{Ic}$ (in.) <sup>a</sup>	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ (ksi $\sqrt{\text{in.}}$ )	$K_{Ic}$ MEAN	STAN DEV		
1450F 1HR AC	Plate	1.00	R.T.	T-L	146.0	3.006	1.000	CT	--	0.23	44.00	--	--	1981	NR001
		1.40													
1700F 6 HR AC 1400F 6 HR AC	Forging	1.40	R.T.	L-T	119.0	3.002	1.365	CT	1.605	0.97	74.10	75.9	4.2	1973	85857
		1.40													
		1.40													
		1.40													
		1.40													
		1.40													
1700F 6 HR AC 1400F 6 HR AC	Forging	1.40	R.T.	T-L	126.0	3.001	1.357	CT	1.615	1.16	81.20	81.2	5.8	1973	85857
		1.40													
		1.40													
		1.40													
		1.40													
		1.40													
1700F 6 HR AC 1400F 6 HR AC	Forging	1.40	R.T.	T-L	127.0	3.004	1.353	CT	1.617	1.18	87.50	81.2	5.8	1973	85857
		1.40													
		1.40													
		1.40													
		1.40													
		1.40													
1750F 1 HR WQ 1000F 4 HR	Forging	1.40	-75	T-L	129.0	3.006	1.279	CT	1.500	0.88	74.80	68.2	2.6	1966	76411
		1.40													
		1.40													
		1.40													
		1.40													
		1.40													
1750F 1 HR WQ 1000F 4 HR	Forging	3.00	-40	T-L	129.0	3.006	1.336	CT	1.568	1.09	85.20	71.5	7.5	1966	76411
		3.00													
		3.00													
		3.00													
		3.00													
		3.00													
1750F 1 HR WQ 1000F 4 HR	Forging	3.00	0	T-L	159.0	5.100	2.000	WOL-CT EQ.	1.998	0.43	66.30	69.7	4.6	1966	76411
		3.00													
		3.00													
		3.00													
		3.00													
		3.00													

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>Ic</sub> /TS) <sup>a</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksi • √in.)	K <sub>Ic</sub> MEAN	STAN DEV		
1750F 1 HR WQ 1000F 4 HR	Forging	3.00	32	T-L	148.0	5.100	2.000	WOL-CT EQ.	2.041	0.47	64.40	65.0	0.8	1966	76411
		3.00			148.0	5.100	2.000	WOL-CT EQ.	2.011	0.49	65.50			1966	76411
1750F 1 HR WQ 1000F 4 HR	Forging	3.00	R.T.	T-L	140.0	5.100	2.000	WOL-CT EQ.	1.986	0.91	84.90	79.3	4.9	1966	76411
		3.00			140.0	5.100	2.000	WOL-CT EQ.	2.019	0.75	76.60			1966	76411
		3.00			140.0	5.100	2.000	WOL-CT EQ.	2.010	0.74	76.30			1966	76411
1750F 1 HR WQ 1000F 4 HR	Forging	3.00	100	T-L	133.0	5.100	2.000	WOL-CT EQ.	1.969	0.75	72.90	71.1	2.5	1966	76411
		3.00			133.0	5.100	2.000	WOL-CT EQ.	2.049	0.68	69.30			1966	76411
1750F 1 HR WQ 1000F 4 HR	Forging	3.00	150	T-L	127.0	5.100	2.000	WOL-CT EQ.	1.970	0.85	74.00	78.0	5.7	1966	76411
		3.00			127.0	5.100	2.000	WOL-CT EQ.	2.033	1.00	82.00			1966	76411
1750F 1HR FC TO 1100F AC	Plate	1.50	R.T.	L-T	120.0	4.005	1.501	CT	1.991	1.20	83.00	--	--	1973	85836
1750F 1HR FC TO 1100F AC	Plate	1.50	R.T.	T-L	120.0	4.004	1.501	CT	1.938	1.41	90.00	91.5	2.1	1973	85836
		1.50			120.0	4.000	1.500	CT	--	1.50	93.00			1974	89004
1750F 1HR FC TO RT	Plate	1.50	R.T.	L-T	120.0	4.004	1.502	CT	1.717	0.84	69.50	71.9	3.2	1973	85836
		1.50			120.0	4.004	1.501	CT	1.718	0.95	74.00			1973	85836
1750F 1HR FC TO RT	Plate	1.50	R.T.	T-L	120.0	4.008	1.502	CT	1.956	1.43	90.60	91.6	1.3	1973	85836
		1.50			120.0	4.003	1.502	CT	1.986	1.49	92.50			1973	85836
1750F 2 HR FC TO 900F AT 100F/HR AC	Forging	3.00	R.T.	L-T	115.0	3.005	1.500	CT	1.716	1.20	79.80	--	--	1973	88440
1750F 2 HR FC TO 900F AT 100F/HR AC	Forging	3.00	R.T.	T-L	130.0	3.005	1.500	CT	1.561	1.21	90.50	--	--	1973	88440
1750F 2HR WQ 1000F 2HR AC 1300F 2 HR AC STA	Plate	0.62	R.T.	L-T	150.0	3.501	0.634	CT	1.865	0.17	39.80	41.4	2.3	1973	85836
		0.62			150.0	3.501	0.633	CT	1.880	0.20	43.00			1973	85836

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5° (K <sub>Ic</sub> /TYS) <sup>a</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksi) • √(in.)	K <sub>Ic</sub> MEAN	STAN DEV		
AB FORGED-MA ALPHA-BETA- FORGED MILL ANNEALED	Forging	---	R.T.	---	133.0	2.500	1.250	CT	1.250	0.57	63.60	58.5	4.4	1973	90584 (1)
		---			133.0	2.500	1.250	CT	1.250	0.50	59.40			1973	90584 (1)
		---			134.0	2.500	1.250	CT	1.250	0.62	66.50			1973	90584 (1)
		---			134.0	2.500	1.250	CT	1.250	0.41	54.10			1973	90584 (1)
		---			134.0	2.500	1.250	CT	1.250	0.43	55.90			1973	90584 (1)
		---			134.0	2.500	1.250	CT	1.250	0.44	56.30			1973	90584 (1)
		2.75			136.0	2.000	1.000	CT	1.000	0.44	57.20			1974	88962 (2)
		2.75			136.0	2.000	1.000	CT	1.000	0.41	55.20			1974	88962 (2)
		2.25			145.0	2.000	1.000	CT	1.065	0.18	38.60			1973	86688
		2.25			145.0	3.000	1.500	CT	1.566	0.12	32.20			1973	86588
AB FORGED-MA ALPHA-BETA- FORGED MILL ANNEALED	Forging	2.25	R.T.	T-L	145.0	2.000	1.000	CT	1.071	0.15	36.00	35.4	2.7	1973	86688
		2.25			145.0	2.000	1.000	CT	1.074	0.14	34.90			1973	86688
		---			128.0	2.500	1.250	CT	1.250	0.74	69.90			1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.79	72.10			1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.72	68.60			1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.70	68.00			1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.74	69.60			1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.70	67.70			1973	90584 (1)
		---			132.0	2.500	1.250	CT	1.250	0.60	64.50			1973	90584 (1)
		---			132.0	2.500	1.250	CT	1.250	0.54	61.70			1973	90584 (1)
AB FORGED-RA ALPHA-BETA FORGED RECRYSTALLIZED ANNEAL 1700F 4 HR FC TO 1000F AC	Forging	---	R.T.	---	128.0	2.500	1.250	CT	1.250	0.74	69.90	67.8	3.3	1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.79	72.10			1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.72	68.60			1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.70	68.00			1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.74	69.60			1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.70	67.70			1973	90584 (1)
		---			132.0	2.500	1.250	CT	1.250	0.60	64.50			1973	90584 (1)
		---			132.0	2.500	1.250	CT	1.250	0.54	61.70			1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.74	69.90			1973	90584 (1)
		---			128.0	2.500	1.250	CT	1.250	0.79	72.10			1973	90584 (1)

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	$2.5 \cdot (K_{Ic}/\sqrt{YS})^2$ (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				THICK (in.) B	DESIGN	WIDTH (in.) W			$K_{Ic}$ (Ksi $\cdot \sqrt{in.}$ )	$K_{Ic}$ MEAN	STAN DEV		
ANNEALED	Forging	1.00	-65	L-T	153.3	2.003	1.001	CT	1.020	0.36	58.20	54.9	5.9	1987	DA006
		1.00			153.3	2.006	0.999	CT	1.074	0.36	58.50			1987	DA006
		3.00			157.4	2.000	1.000	CT	1.023	0.23	48.10			1987	DA007
		3.00			154.5	2.000	0.953	CT	1.046	0.22	46.30			1987	DA007
ANNEALED	Forging	3.00	-65	T-L	154.5	2.000	0.998	CT	1.043	0.24	47.60	46.2	1.5	1987	DA007
		1.50			166.2	3.010	1.491	CT	1.656	0.18	44.10			1987	DA006
		1.50			166.2	3.012	1.491	CT	1.628	0.20	46.87			1987	DA006
		3.00			114.0	3.001	1.501	CT	1.566	1.41	85.70			1973	85034
ANNEALED	Forging	3.00	R.T.	L-T	119.0	2.998	1.500	CT	1.556	1.22	83.10	70.7	15.9	1973	85034
		1.50			131.7	3.011	1.502	CT	1.573	0.50	58.90			1987	DA006
		1.50			131.7	3.011	1.502	CT	1.566	0.44	55.30			1987	DA006
		3.00			118.0	3.003	1.500	CT	1.549	1.46	90.40			1973	85034
ANNEALED	Forging	3.00	R.T.	T-L	120.0	3.001	1.494	CT	1.618	1.01	76.40	67.3	13.6	1973	85034
		3.00			140.1	3.007	1.495	CT	1.566	0.48	61.40			1987	DA007
		3.00			140.1	3.005	1.495	CT	1.558	0.52	63.60			1987	DA007
		1.50			144.9	3.010	1.506	CT	1.589	0.39	57.10			1987	DA006
		1.50			144.9	3.012	1.501	CT	1.625	0.36	54.70			1987	DA006
		1.50			144.9	3.012	1.501	CT	1.625	0.36	54.70			1987	DA006

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>Ic</sub> /TYS) <sup>a</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksi • √in.)	K <sub>Ic</sub> MEAN	STAN DEV		
ANNEALED	Extrusion	1.75	-65	L-T	146.8	3.000	1.498	CT	1.571	0.71	78.20	75.9	2.4	1987	DA007
		1.75			146.8	3.010	1.497	CT	1.556	0.70	77.50			1987	DA007
		1.50			152.5	3.005	1.501	CT	1.422	0.57	72.90			1987	DA006
		1.50			152.5	3.007	1.510	CT	1.427	0.61	75.10			1987	DA006
ANNEALED	Extrusion	1.75	-65	T-L	149.2	3.000	1.498	CT	1.554	0.70	79.20	76.9	1.7	1987	DA007
		1.75			149.2	3.006	1.499	CT	1.598	0.67	77.10			1987	DA007
		1.50			157.2	3.007	1.504	CT	1.431	0.58	75.50			1987	DA006
		1.50			157.2	3.008	1.502	CT	1.425	0.58	75.90			1987	DA006
ANNEALED	Extrusion	4.00	R.T.	L-T	122.0	4.006	1.624	CT	2.027	1.42	92.00	82.6	5.3	1973	85536 (1)
		1.75			127.2	3.005	1.500	CT	1.589	1.00	80.60			1987	DA007
		1.75			127.2	3.007	1.500	CT	1.577	1.00	80.30			1987	DA007
		1.50			131.6	3.008	1.501	CT	1.637	0.93	80.20			1987	DA006
ANNEALED	Extrusion	1.50	R.T.	T-L	131.6	3.007	1.502	CT	1.437	0.92	79.90	85.2	6.5	1987	DA006
		4.00			122.0	4.003	1.629	CT	2.027	1.51	94.90			1973	85536 (1)
		4.00			122.0	4.005	1.625	CT	1.995	1.41	91.70			1973	85536 (1)
		1.75			127.9	3.005	1.500	CT	1.571	1.06	83.40			1987	DA007
ANNEALED	Extrusion	1.75	R.T.	T-L	127.9	3.009	1.498	CT	1.627	1.02	81.80	85.2	6.5	1987	DA007
		1.50			131.4	2.007	1.502	CT	1.439	0.91	79.20			1987	DA006
		1.50			131.4	3.008	1.493	CT	1.465	0.93	80.30			1987	DA006
		6.00			123.0	2.501	1.250	CT	1.249	0.87	72.80			1975	MA003
ANNEALED	Billet	6.00	R.T.	L-T	123.0	2.500	1.251	CT	1.241	1.23	86.40	79.6	9.6	1975	MA003
ANNEALED 1000F 2 HR AC	Billet	2.30	R.T.	L-T	145.0	2.498	1.250	CT	1.264	0.30	50.50	50.9	0.6	1971	84360
		2.30			145.0	2.500	1.249	CT	1.250	0.31	51.30			1971	84360

NOTES: (1) COMPOSITION (WT PERCENT) 6.35Al, 4.31V, 0.22C, 0.16Fe, 0.09N, 0.06H, 0.16O



TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>Ic</sub> /√B) <sup>2</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksi • √in.)	K <sub>Ic</sub> MEAN	STAN DEV		
ANNEALED 1300F 4 HR AC	Forging	2.30	-65	L-T	145.0	1.500	0.750	CT	---	0.28	48.40	56.8	11.8	1974	89504
		2.30			145.0	1.500	0.750	CT	---	0.50	65.10			1974	89504
ANNEALED 1300F 4 HR AC	Forging	2.30	-65	T-L	151.0	1.500	0.750	CT	---	0.28	50.40	57.8	11.4	1974	89504
		2.30			151.0	1.500	0.750	CT	---	0.55	70.90			1974	89504
		2.30			151.0	1.500	0.750	CT	---	0.30	52.20			1974	89504
		2.30			146.0	1.500	0.750	CT	---	0.50	65.00			1974	89504
ANNEALED 1300F 4 HR AC	Forging	2.30	-65	S-T	146.0	1.500	0.750	CT	---	0.28	49.00	58.9	8.0	1974	89504
		2.30			146.0	1.500	0.750	CT	---	0.38	56.60			1974	89504
		2.30			146.0	1.500	0.750	CT	---	0.36	55.00			1974	89504
		2.30			146.0	1.500	0.750	CT	---	0.42	59.70			1974	89504
ANNEALED 1300F 4 HR AC	Forging	2.30	-65	S-L	146.0	1.500	0.750	CT	---	0.40	58.30	57.7	2.4	1974	89504
		2.30			129.0	1.500	0.750	CT	---	0.49	57.20			1974	89504
		2.30			129.0	1.500	0.750	CT	---	0.50	57.60			1974	89504
		2.30			129.0	1.500	0.750	CT	---	0.53	59.40			1974	89504
ANNEALED 1300F 4 HR AC	Forging	2.30	R.T.	L-T	132.0	1.500	0.750	CT	---	0.61	65.20	58.1	1.2	1974	89504
		2.30			132.0	1.500	0.750	CT	---	0.55	62.10			1974	89504
		2.30			132.0	1.500	0.750	CT	---	0.50	59.20			1974	89504
		2.30			129.0	1.500	0.750	CT	---	0.49	56.90			1974	89504
ANNEALED 1300F 4 HR AC	Forging	2.30	R.T.	S-T	128.0	1.500	0.750	CT	---	0.53	59.00	58.1	1.1	1974	89504
		2.30			128.0	1.500	0.750	CT	---	0.52	58.40			1974	89504
		2.30			128.0	1.500	0.750	CT	---	0.52	58.40			1974	89504
		2.30			128.0	1.500	0.750	CT	---	0.52	58.40			1974	89504

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>Ic</sub> /TS) <sup>2</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksi • √in.)	K <sub>Ic</sub> MEAN	STAN DEV		
ANNEALED 1300F 4 HR AC	Forging	2.30	R.T.	S-L	128.0	1.500	0.750	CT	---	0.69	67.40	68.1	1.0	1974	89504
		2.30			128.0	1.500	0.750	CT	---	0.72	69.80			1974	89504
ANNEALED 1375F 3 HR AC	Plate	2.75	R.T.	L-T	128.0	2.489	1.250	CT	1.224	0.48	58.59	60.4	5.5	1975	MA003
		2.75			128.0	2.497	1.250	CT	1.200	0.62	64.30			1975	MA003
ANNEALED 2200F 2 HR	Forging	1.00	R.T.	--	140.0	2.000	1.000	CT	1.000	0.50	62.80	57.5	3.9	1974	89562 (1)
		1.00			140.0	2.000	1.000	CT	1.000	0.43	58.20			1974	89562 (1)
		1.00			140.0	2.000	1.000	CT	1.000	0.39	55.20			1974	89562 (1)
		1.00			140.0	2.000	1.000	CT	1.000	0.44	58.80			1974	89562 (1)
		1.00			140.0	2.000	1.000	CT	1.000	0.35	52.40			1974	89562 (1)
		--			124.0	2.000	1.002	CT	1.020	0.61	61.10			1974	90012
AS RECEIVED	Forged Bar	--	R.T.	L-T	126.0	2.006	1.000	CT	1.074	0.59	61.80	57.1	10.4	1974	90012
		3.50			126.0	1.998	1.001	CT	1.019	0.62	62.50			1974	90012
		1.80			126.0	1.997	0.625	CT	0.994	0.59	61.30			1974	90012
		3.50			129.0	1.996	1.002	CT	1.006	0.48	56.60			1974	90012
		--			130.0	1.998	1.000	CT	1.029	0.79	72.90			1974	90012
		--			130.0	2.000	1.000	CT	1.053	0.53	60.10			1974	90012
		3.50			131.0	1.998	0.998	CT	1.036	0.72	70.60			1974	90012
		1.30			134.0	2.000	0.563	CT	1.005	0.32	47.70			1974	90012
		--			134.0	1.998	1.003	CT	1.013	0.61	66.10			1974	90012
		1.50			136.0	1.998	1.003	CT	1.053	0.20	38.40			1974	90012
		2.50			137.0	2.000	0.999	CT	1.032	0.37	52.50			1974	90012
		2.60			137.0	2.001	1.000	CT	1.021	0.24	42.60			1974	90012
		2.70			143.0	2.001	0.999	CT	1.022	0.26	45.70			1974	90012

NOTES: (1) INTERMEDIATE GRAIN SIZE

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	ΔK <sub>TS</sub> <sup>a</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> • √(in.)	K <sub>Ic</sub> MEAN	STAN DEV		
AS RECEIVED	Forged Bar	3.50	R.T.	T-L	127.0	1.998	0.998	CT	1.084	0.68	66.40	54.9	10.8	1974	90012
		--			128.0	1.998	0.752	CT	1.023	0.42	52.50			1974	90012
		1.80			129.0	1.997	0.779	CT	1.018	0.66	66.50			1974	90012
		1.50			130.0	1.998	0.502	CT	1.000	0.41	52.60			1974	90012
		--			130.0	1.999	0.645	CT	0.998	0.43	54.00			1974	90012
		2.00			131.0	1.998	1.003	CT	1.023	0.53	60.10			1974	90012
		1.50			132.0	1.999	1.002	CT	1.055	0.16	33.80			1974	90012
		--			133.0	2.000	1.002	CT	1.027	0.69	69.90			1974	90012
		--			133.0	1.998	1.001	CT	1.024	0.50	59.40			1974	90012
		3.50			133.0	1.998	1.005	CT	1.045	0.56	62.70			1974	90012
		3.50			134.0	2.000	1.000	CT	1.028	0.58	64.50			1974	90012
		1.50			135.0	1.996	0.560	CT	0.994	0.45	57.40			1974	90012
		--			135.0	2.003	1.001	CT	1.023	0.46	57.80			1974	90012
		--			139.0	2.001	1.002	CT	1.016	0.44	58.20			1974	90012
		--			139.0	2.000	0.654	CT	1.010	0.37	53.50			1974	90012
		--			139.0	1.998	1.003	CT	1.033	0.35	52.10			1974	90012
		2.60			140.0	2.002	0.999	CT	1.014	0.14	32.80			1974	90012
		1.30			141.0	2.002	1.001	CT	1.033	0.18	37.40			1974	90012
		1.80			142.0	1.999	0.999	CT	1.048	0.36	53.70			1974	90012
		1.00			142.0	1.993	1.001	CT	1.054	0.55	66.80			1974	90012
		2.50			145.0	2.000	0.999	CT	1.028	0.19	40.10			1974	90012

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksd)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>sd</sub> /TS) <sup>3</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksd • √in.)	K <sub>Ic</sub> MEAN	STAN DEV		
AS RECEIVED-AB (ALPHA-BETA FORGED)	Forged Bar	3.50	R.T.	L-T	127.0	2.000	1.000	CT	1.023	0.92	77.10	--	--	1974	90012
AS RECEIVED-AB (ALPHA-BETA FORGED)	Forged Bar	3.50	R.T.	T-L	131.0	2.000	1.000	CT	1.023	0.95	80.90	--	--	1974	90012
B FORGED BETA FORGED REHEATED TO 1960F DRAWN TO SIZE ANNEALED 1300F	Forged Bar	2.25	R.T.	T-L	135.0	2.000	1.000	CT	1.046	0.30	48.80	42.6	4.3	1973	86588
		2.25			135.0	3.000	1.500	CT	1.471	0.20	37.80			1973	86688
		2.25			135.0	2.000	1.000	CT	1.038	0.28	45.60			1973	86688
		2.25			135.0	2.000	1.000	CT	1.068	0.22	40.20			1973	86588
B FORGED-MA BETA FORGED MILL ANNEALED 1300F 2 HR AC	Forging	2.75	R.T.	---	131.0	2.000	1.000	CT	1.000	0.88	77.70	75.3	3.4	1974	88962 (1)
		2.75			131.0	2.000	1.000	CT	1.000	0.77	72.90			1974	88962 (1)
B FORGED-MA BETA FORGED MILL ANNEALED 1300F 2 HR AC	Forging	2.00	R.T.	L-T	137.0	2.000	1.000	CT	---	0.59	66.40	70.6	4.9	1971	80538
		2.00			137.0	2.000	1.000	CT	---	0.77	76.00			1971	80538
		2.00			137.0	2.000	1.000	CT	---	0.64	69.30			1971	80538
B FORGED-MA BETA FORGED MILL ANNEALED 1300F 2 HR AC	Forging	2.00	R.T.	T-L	131.0	2.000	1.000	CT	---	0.73	70.60	71.0	0.4	1971	80538
		2.00			131.0	2.000	1.000	CT	---	0.74	71.10			1971	80538
		2.00			131.0	2.000	1.000	CT	---	0.74	71.40			1971	80538
B FORGED-MA BETA FORGED MILL ANNEALED 1300F 2 HR AC	Forging	2.00	R.T.	S-L	132.0	2.000	1.000	CT	---	0.74	72.10	73.9	2.5	1971	80538
		2.00			132.0	2.000	1.000	CT	---	0.82	75.70			1971	80538

NOTES: (1) COMP. DISK

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>1</sub> TYS) <sup>a</sup> (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ (ksi • √in.)	$K_{Ic}$ MEAN	STAN DEV		
BB AB FIN-30MA BETA BLOCKED ALPHA-BETA FINISHED 30% REDUCTION MILL ANNEALED 1300F 2 HR AC	Forging	2.50	R.T.	--	127.0	2.000	1.000	CT	1.000	1.00	80.50	78.2	3.3	1974	88962
		2.50									2.000				
BB AB FIN-MA BETA BLOCKED ALPHA-BETA FINISHED MILL ANNEALED	Forging	--	R.T.	--	132.0	2.500	1.250	CT	1.250	0.78	73.50	72.3	5.6	1973	90584 (1)
		--			132.0	2.500	1.250	CT	1.250	0.89	78.70			1973	90584 (1)
		--			134.0	2.500	1.250	CT	1.250	0.59	65.10			1973	90584 (1)
		--			134.0	2.500	1.250	CT	1.250	0.72	72.10			1973	90584 (1)
BB AB FIN-RA BETA BLOCKED ALPHA-BETA FINISHED RECRYSTALLIZED ANNEAL 1700F 4HR FC TO 1000F AC	Forging	--	R.T.	--	135.0	2.500	1.250	CT	1.250	0.89	80.70	75.1	4.3	1973	90584 (1)
		--			135.0	2.500	1.250	CT	1.250	0.76	74.40			1973	90584 (1)
		--			137.0	2.500	1.250	CT	1.250	0.74	74.80			1973	90584 (1)
		--			137.0	2.500	1.250	CT	1.250	0.66	70.30			1973	90584 (1)
BB AB FIN10STO BETA-BLOCKED ALPHA-BETA FINISHED 10% REDUCTION SOLUTION TREATED & OVERAGED 1750F 1HR WQ 1300F 2HR AC	Forging	2.50	R.T.	--	136.0	2.000	1.000	CT	1.000	0.84	79.00	81.7	3.4	1974	88962
		2.50			2.000	1.000	CT	1.000	0.89	85.50	1974			88962	
		2.50			2.000	1.000	CT	1.000	0.88	80.50	1974			88962	
BB AB FIN30STO BETA-BLOCKED ALPHA-BETA FINISHED 30% REDUCTION SOLUTION TREATED & OVERAGED 1750F 1HR WQ 1300F 2HR AC	Forging	2.50	R.T.	--	137.0	2.000	1.000	CT	1.000	0.81	78.00	73.1	5.3	1974	88962
		2.50			2.000	1.000	CT	1.000	0.60	67.40	1974			88962	
		2.50			2.000	1.000	CT	1.000	0.72	73.80	1974			88962	

NOTES: (1) F-14 OUTBOARD COVER

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (K <sub>ad</sub> )	SPECIMEN			CRACK LENGTH (in.) A	2.5° (K <sub>Ic</sub> /√YS) <sup>a</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (K <sub>ad</sub> • √in.)	K <sub>Ic</sub> MEAN	STAN DEV		
BB B FIN-10MA BETA BLOCKED BETA FINISHED 10% REDUCTION MILL ANNEALED 1300F 2HR AC	Forging	2.50	R.T.	---	128.0	2.000	1.000	CT	1.000	0.85	74.50	73.3	1.9	1974	88962
		2.50			128.0	2.000	1.000	CT	1.000	0.84	74.40			1974	88962
		2.50			128.0	2.000	1.000	CT	1.000	0.77	71.10			1974	88962
BB B FIN10STOA BETA BLOCKED BETA FINISHED 10% REDUCTION SOLUTION TREATED & OVERAGED 1750F 1HR WQ 1300F 2HR AC	Forging	2.50	R.T.	---	138.0	2.000	1.000	CT	1.000	0.86	85.60	86.1	0.5	1974	88962
		2.50			138.0	2.000	1.000	CT	1.000	0.98	86.40			1974	88962
		2.50			138.0	2.000	1.000	CT	1.000	0.88	86.40			1974	88962
BETA ANNEALED	Plate	2.50	-65	L-T	125.0	4.003	1.991	CT	2.116	2.06	113.50	108.4	2.8	1974	88575
		2.50			125.0	4.005	2.000	CT	2.152	1.95	110.50			1974	88575
		2.50			125.0	3.997	2.001	CT	2.072	1.90	109.10			1974	88575
		2.50			125.0	4.003	1.998	CT	2.105	1.79	105.90			1974	88575
		2.50			125.0	4.009	2.005	CT	2.084	1.86	108.00			1974	88575
BETA ANNEALED	Plate	1.00	R.T.	T-L	126.0	2.550	1.000	WOL-CT EQ.	--	0.98	79.20	--	--	1977	JEM01
BETA ANNEALED PLATE EB WELDED THEN BETA ANNEALED, EB WELD IN PLANE OF FRACTURE	Plate	2.50	R.T.	---	116.0	1.994	0.999	CT	1.133	0.90	69.80	69.2	0.9	1974	88575
		2.50			116.0	1.992	0.951	CT	1.140	0.87	68.50			1974	88575
BETA PROCESSED MILL ANNEALED	Plate	3.00	R.T.	L-T	130.4	3.000	1.500	CT	---	1.44	99.00	94.9	4.8	1975	UD008
		3.00			130.4	3.000	1.500	CT	---	1.35	96.00			1975	UD008
		3.00			130.4	3.000	1.500	CT	---	1.18	89.60			1975	UD008

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>IC</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (K <sub>sat</sub> )	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>IC</sub> /TYS) <sup>a</sup> (in.)	K <sub>IC</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>IC</sub> • √(in.)	K <sub>IC</sub> MEAN	STAN DEV		
DIFFUSION BOND ANNEALED - 1750F 1.5-4HR FC TO 900F AT 100F/HR	Billet	3.50	R.T.	L-T	127.0	2.000	1.000	CT	1.072	0.93	77.50	88.2	9.7	1974	90012
		1.00			128.0	2.001	1.002	CT	1.092	0.98	80.70			1974	90012
		---			129.0	2.002	1.004	CT	1.032	0.75	70.80			1974	90012
		1.50			132.0	2.000	1.003	CT	1.019	0.45	56.10			1974	90012
		---			132.0	1.995	1.000	CT	1.083	0.83	76.30			1974	90012
		3.50			132.0	1.999	1.003	CT	1.029	0.68	69.00			1974	90012
		2.60			133.0	1.998	0.975	CT	1.017	0.48	58.10			1974	90012
		3.50			134.0	1.999	1.000	CT	1.030	0.69	70.40			1974	90012
		2.70			137.0	2.000	1.001	CT	1.024	0.40	54.70			1974	90012
		---			125.0	1.997	0.676	CT	0.992	0.65	64.00			1974	90012
DIFFUSION BOND ANNEALED - 1750F 1.5-4HR FC TO 900F AT 100F/HR	Billet	---	R.T.	T-L	125.0	2.000	1.003	CT	1.032	0.80	70.80	64.2	11.8	1974	90012
		---			128.0	2.001	0.999	CT	1.043	0.90	76.90			1974	90012
		3.50			131.0	1.995	1.000	CT	1.048	0.84	76.00			1974	90012
		3.50			132.0	1.998	0.999	CT	1.013	0.67	68.20			1974	90012
		2.00			133.0	1.998	1.000	CT	1.028	0.75	72.70			1974	90012
		3.50			133.0	2.000	0.999	CT	1.019	0.72	71.40			1974	90012
		1.50			134.0	2.000	1.000	CT	1.043	0.39	53.10			1974	90012
		---			135.0	2.000	1.001	CT	1.033	0.66	69.20			1974	90012
		2.50			137.0	1.998	0.877	CT	1.021	0.33	49.50			1974	90012
		2.60			138.0	1.997	0.979	CT	1.031	0.27	45.10			1974	90012
2.70	140.0	2.000	1.004	CT	1.018	0.25	44.60	1974	90012						
1.00	142.0	2.001	1.000	CT	1.042	0.66	72.70	1974	90012						

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>Ic</sub> /√S) <sup>2</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksi • √in.)	K <sub>Ic</sub> MEAN	STAN DEV		
DIFFUSION BONDED - 1700F 4HR FC TO 1400F AT 100F/HR THEN TO 900F IN 0.75HR	Plate	0.62	R.T.	---	120.0	4.005	2.002	CT	1.966	1.47	92.10	--	--	1973	85836
DIFFUSION BONDED - 1700F 4HR FC TO 1400F AT 100F/HR THEN TO 900F IN 0.75HR	Plate	0.62	R.T.	L-T	120.0	3.004	1.500	CT	1.574	1.11	79.90	--	--	1973	85836
DIFFUSION BONDED - 1700F 4HR FC TO 1400F AT 100F/HR THEN TO 900F IN 0.75HR	Plate	0.62	R.T.	T-L	120.0	3.005	1.501	CT	1.575	1.20	83.10	--	--	1973	85836
DIFFUSION BONDED - 1700F 4HR FC TO 1400F AT 100F/HR THEN TO 900F IN 0.75HR	Plate	1.50	R.T.	S-T	120.0	4.000	1.500	CT	--	1.34	88.00	85.7	3.2	1974	89004
		1.50			120.0	4.000	1.500	CT	--	1.16	82.00			1974	89004
		1.50			120.0	4.000	1.500	CT	--	1.31	87.00			1974	89004
DIFFUSION BONDED - 1700F 4HR FC TO 1400F AT 100F/HR THEN TO 900F IN 0.75HR	Plate	2.50	R.T.	S-L	120.0	4.000	1.500	CT	--	1.14	81.00	--	--	1974	89004
DIFFUSION BONDED - 1700F 4HR FC TO 1400F AT 100F/HR THEN TO 900F IN 0.75HR	Billet	0.62	R.T.	L-T	120.0	3.000	1.500	CT	--	1.11	80.00	--	--	1974	89004
DIFFUSION BONDED - 1700F 4HR FC TO 1400F AT 100F/HR THEN TO 900F IN 0.75HR	Billet	0.62	R.T.	T-L	120.0	3.000	1.500	CT	--	1.20	83.00	--	--	1974	89004



TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	$\Delta K_{Ic}$ (in.) (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ (Ksi) (in.) $\sqrt{in.}$	$K_{Ic}$ MEAN	STAN DEV		
DIFFUSION BONDED - 1700F 4HR FC TO 1400F AT 100F/HR THEN TO 900F IN 0.75HR	Billet	8.00	R.T.	S-T	---	3.995	1.495	CT	1.928	1.32	87.40	88.0	3.6	1972	84306
		8.00				3.999	1.457	CT	1.881	1.18	82.40			1972	84306
		8.00				3.998	1.495	CT	1.920	1.33	87.80			1972	84306
		8.00				3.998	1.495	CT	1.963	1.43	90.90			1972	84306
		8.00				3.998	1.492	CT	1.969	1.45	91.60			1972	84306
MA 10-20%ALPHA 10 TO 20% PRIMARY ALPHA MILL ANNEALED 1300F 2 HR AC	Forging	2.50	R.T.	---	---	2.000	1.000	CT	1.000	0.67	73.10	69.4	3.2	1974	88962
		2.50				2.000	1.000	CT	1.000	0.58	68.00			1974	88962
		2.50				2.000	1.000	CT	1.000	0.57	67.10			1974	88962
MA 40-50%ALPHA 40 TO 50% PRIMARY ALPHA MILL ANNEALED 1300F 2 HR AC	Forging	2.50	R.T.	---	---	2.000	1.000	CT	1.000	0.70	71.50	69.1	3.4	1974	88962
		2.50				2.000	1.000	CT	1.000	0.68	70.60			1974	88962
		2.50				2.000	1.000	CT	1.000	0.58	65.20			1974	88962
MA COARSE GRAIN 1300F 2 HR AC	Forging	14.00	R.T.	---	---	2.000	1.000	CT	1.000	0.40	55.30	53.9	2.0	1974	88962
		14.00				2.000	1.000	CT	1.000	0.36	53.20			1974	88962
		14.00				2.000	1.000	CT	1.000	0.35	52.20			1974	88962
		14.00				2.000	1.000	CT	1.000	0.42	56.70			1974	88962
		14.00				2.000	1.000	CT	1.000	0.35	52.10			1974	88962
MA FINE GRAIN 1300F 2 HR AC	Forging	6.00	R.T.	---	---	2.000	1.000	CT	1.000	0.85	80.60	69.5	7.7	1974	88962
		6.00				2.000	1.000	CT	1.000	0.76	76.10			1974	88962
		6.00				2.000	1.000	CT	1.000	0.46	59.60			1974	88962
		6.00				2.000	1.000	CT	1.000	0.62	69.10			1974	88962
		6.00				2.000	1.000	CT	1.000	0.60	67.60			1974	88962
		6.00				2.000	1.000	CT	1.000	0.54	64.00			1974	88962

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • $(K_{Ic}/\sqrt{TS})^2$ (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ (Ksi • $\sqrt{\text{in.}}$ )	$K_{Ic}$ MEAN	STAN DEV		
MILL ANNEAL	Plate	1.50	R.T.	L-T	133.0	2.496	1.244	CT	1.330	0.45	56.59	55.6	1.3	1981	MA002
		1.50			133.0	2.502	1.255	CT	1.297	0.42	54.70			1981	MA002
MILL ANNEAL	Plate	1.00	R.T.	T-L	146.1	2.550	1.000	WOL-CT EQ.	--	0.17	38.20	--	--	1977	JEM01
MILL ANNEALED	Plate	2.00	-85	T-L	157.0	4.000	2.004	CT	1.970	1.03	89.70	87.9	2.0	1973	88144
		2.00			157.0	4.000	2.002	CT	1.980	0.94	85.70			1973	88144
		2.00			157.0	4.000	2.003	CT	1.990	0.99	88.20			1973	88144
MILL ANNEALED	Plate	2.00	R.T.	L-T	127.0	4.000	2.003	CT	2.137	1.94	112.00	--	--	1972	85084
MILL ANNEALED	Plate	1.25	R.T.	T-L	119.4	3.495	1.245	CT	1.741	1.16	95.30	100.6	6.8	1972	84306
		1.25			119.4	3.499	1.245	CT	1.824	1.20	97.00			1972	84306
		1.25			119.4	3.500	1.247	CT	1.817	1.15	94.80			1972	84306
		2.00			126.0	4.000	2.002	CT	2.038	1.53	98.70			1972	85064
		2.00			126.0	4.000	2.001	CT	2.097	1.94	112.00			1972	85064
		2.00			126.0	4.000	2.002	CT	2.048	1.75	105.50			1972	85084
MILL ANNEALED	Extrusion	4.00	R.T.	L-T	123.5	3.997	1.465	CT	1.967	1.21	87.60	83.5	3.1	1972	84306 (1)
		1.80			124.0	3.934	1.578	CT	2.031	1.17	85.09			1976	NC001
		1.80			124.0	3.930	1.578	CT	2.036	1.12	83.06			1976	NC001
		1.80			124.5	3.995	1.577	CT	2.049	1.09	82.37			1976	NC001
		1.80			124.5	3.995	1.578	CT	2.115	1.01	79.17			1976	NC001

NOTES: (1) COMPOSITION (WT PERCENT) 6.51Al, 4.86V, 0.024C, 0.19Fe, 0.012V, 0.068H, 0.15O

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • $(K_{Ic}/YTS)^2$ (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ (Ksi • $\sqrt{\text{in.}}$ )	$K_{Ic}$ MEAN	STAN DEV		
MILL ANNEALED	Extrusion	4.00	R.T.	T-L	---	4.000	1.498	CT	1.947	1.30	92.50	87.5	4.1	1972	84306 (1)
		4.00				4.000	1.498	CT	2.084	1.29	92.10			1972	84306 (1)
		1.80				3.995	1.575	CT	2.102	1.06	81.82			1976	NC001
		1.80				3.995	1.577	CT	2.113	1.21	87.42			1976	NC001
		1.80				3.995	1.578	CT	2.096	1.13	85.71			1976	NC001
		1.80				3.938	1.577	CT	2.079	1.13	85.64			1976	NC001
MILL ANNEALED 1300F 2 HR AC	Forging	2.00	R.T.	L-T	---	2.000	1.000	CT	---	0.30	45.40	47.7	2.9	1971	80538
		2.00				2.000	1.000	CT	---	0.31	46.70			1971	80538
		2.00				2.000	1.000	CT	---	0.37	51.00			1971	80538
MILL ANNEALED 1300F 2 HR AC	Forging	2.00	R.T.	T-L	---	2.000	1.000	CT	---	0.30	46.50	49.5	3.9	1971	80538
		2.00				2.000	1.000	CT	---	0.41	53.90			1971	80538
		2.00				2.000	1.000	CT	---	0.32	48.00			1971	80538
MILL ANNEALED 1300F 2 HR AC	Forging	2.00	R.T.	S-L	---	2.000	1.000	CT	---	0.31	49.50	43.6	5.8	1971	80538
		2.00				2.000	1.000	CT	---	0.18	37.90			1971	80538
		2.00				2.000	1.000	CT	---	0.24	43.50			1971	80538
MILL ANNEALED 1300F 2 HR AC	Billet	2.30	R.T.	L-T	---	2.500	1.250	CT	1.277	1.13	80.30	84.0	3.4	1971	84360
		2.30				2.498	1.251	CT	1.225	1.11	85.00			1971	84360
		2.30				2.500	1.253	CT	1.271	1.16	86.80			1971	84360
MILL ANNEALED 1300F 2HR AC	Forging	4.50	R.T.	L-T	---	2.498	1.248	CT	1.355	0.54	60.59	---	---	1981	MA002
RECRYSTALLIZE ANNEAL	Plate	1.50	-65	L-T	---	3.999	1.502	CT	2.044	0.63	60.40	---	---	1972	84306 (2)
RECRYSTALLIZE ANNEAL	Plate	1.50	-65	T-L	---	3.997	1.496	CT	2.110	1.03	77.00	---	---	1972	84306 (2)

NOTES: (1) COMPOSITION (WT PERCENT) 6.35AL, 4.31V, 0.22C, 0.16Fe, 0.09N, 0.06H, 0.16O  
 (2) 1700F 4HR FC TO 1400F AT 100F/HR COOL TO 900F IN .75HR

TABLE 6.16.2.1 (CONTINUED)

17 of 23

TITANIUM Ti-6Al-4V $K_{Ic}$																	
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • $(K_{Ic}/\sqrt{S})^2$ (in.)	$K_{Ic}$			DATE	REFER		
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ • $\sqrt{(in.)}$	$K_{Ic}$ MEAN	STAN DEV				
RECRYSTALLIZE ANNEAL - 1700F 4HR FC TO 1400F AT 100F/HR COOL TO 900F IN .75HR	Plate	1.50	R.T.	L-T	118.0	4.005	1.502	CT	2.004	1.08	79.00	82.8	7.8	1972	84306		
		1.50			118.0	4.003	1.502	CT	2.021	0.97	74.90			1972	84306		
		2.00			119.0	6.002	1.780	CT	3.075	1.64	97.30			1972	84306		
		2.00			119.0	6.003	1.873	CT	3.138	1.62	96.60			1972	84306		
		2.50			120.0	4.000	2.000	CT	---	0.85	74.00			1974	89004		
		1.50			120.0	4.000	1.501	CT	2.103	1.16	81.80			1973	85836		
		1.25			120.0	---	1.250	CT	---	1.08	79.00			1974	89004		
		2.50			120.0	2.999	1.128	CT	1.526	0.83	69.00			1973	85836		
		1.25			120.0	---	1.250	CT	---	1.03	77.00			1974	89004		
		2.50			120.0	---	---	CT	---	1.38	89.00			1974	89004		
		1.25			120.0	---	1.250	CT	---	0.86	75.00			1974	89004		
		2.50			120.0	---	---	CT	---	1.31	87.00			1974	89004		
		1.25			120.0	---	1.250	CT	---	0.92	73.00			1974	89004		
		2.50			120.0	4.000	2.000	CT	---	1.17	82.00			1974	89004		
		1.25			120.0	---	1.250	CT	---	1.14	81.00			1974	89004		
		1.50			120.0	6.000	1.370	CT	---	1.11	80.00			1974	89004		
		2.50			120.0	4.000	2.000	CT	---	1.11	80.00			1974	89004		
		1.50			121.0	6.002	1.496	CT	3.080	1.44	91.00			1972	84306		
		1.50			121.0	3.500	1.500	CT	---	1.44	92.00			1974	89004		
		1.50			121.0	6.003	1.500	CT	3.103	1.30	86.60			1972	84306		
		1.50			121.0	6.001	1.497	CT	3.065	1.41	90.20			1972	84306		
		1.50			121.0	3.500	1.500	CT	---	1.29	87.00			1974	89004		

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>1</sub> TS) <sup>2</sup> (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ (Ksi • √in.)	$K_{Ic}$ MEAN	STAN DEV		
RECRYSTALLIZE ANNEAL = 1700F 4HR FC TO 1400F AT 100F/HR COOL TO 900F IN .75HR	Plate	2.50	R.T.	T-L	120.0	3.000	1.108	CT	1.520	0.83	69.30	80.8	10.8	1973	85836
		1.25			120.0	--	1.250	CT	--	0.92	73.00			1974	89004
		2.50			120.0	4.000	2.000	CT	--	1.25	85.00			1974	89004
		1.25			120.0	--	1.250	CT	--	1.00	76.00			1974	89004
		2.50			120.0	4.000	2.000	CT	--	0.83	69.00			1974	89004
		2.50			120.0	--	--	CT	--	1.50	93.00			1974	89004
		2.00			120.0	6.001	2.009	CT	3.048	1.97	106.40			1973	85836
		1.25			120.0	--	1.250	CT	--	0.95	74.00			1974	89004
		1.50			120.0	6.000	1.370	CT	--	1.28	86.00			1974	89004
		1.50			120.0	4.001	1.498	CT	2.131	1.45	91.50			1973	85836
		1.25			120.0	--	1.250	CT	--	1.14	81.00			1974	89004
		2.50			120.0	4.000	2.000	CT	--	0.98	75.00			1974	89004
		1.50			120.0	3.000	1.500	CT	--	1.25	85.00			1974	89004
		2.50			120.0	--	--	CT	--	1.44	91.00			1974	89004
		2.50			120.0	3.000	1.127	CT	1.544	0.90	71.90			1973	85838
		2.00			120.0	5.999	1.997	CT	3.056	1.79	101.50			1973	85836
		2.50			120.0	2.999	1.374	CT	1.634	0.84	69.40			1973	85836
		2.50			120.0	--	--	CT	--	1.14	81.00			1974	89004
		1.25			120.0	--	1.250	CT	--	0.85	70.00			1974	89004
		2.50			120.0	4.000	2.000	CT	--	1.00	76.00			1974	89004
		1.50			121.0	3.500	1.500	CT	--	1.18	83.00			1974	89004
		1.00			135.0	2.550	1.000	WOL-CT EQ.	--	0.65	69.20			1977	JEM01(1)

NOTES: (1) TYS APPROX. 120

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksd)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>Ic</sub> /TYS) <sup>2</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksd • √(in.))	K <sub>Ic</sub> MEAN	STAN DEV		
RECRYSTALLIZE ANNEAL - 1700F 4HR FC TO 1400F AT 100F/HR COOL TO 900F IN .75HR	Forging	--	--	L-T	--	3.000	1.500	CT	--	1.03	77.00	83.6	5.5	1974	89004
		--	--		4.000	2.020	CT	--	1.20	83.00	1974			89004	
		--	--		3.000	1.500	CT	--	0.92	73.00	1974			89004	
		--	--		4.000	1.790	CT	--	1.06	78.00	1974			89004	
		2.25			114.0	2.997	1.499	CT	1.528	1.43	86.10			1973	85034
		2.25			115.0	2.999	1.500	CT	1.524	1.49	89.00			1973	85034
		2.25			116.0	2.998	1.499	CT	1.535	1.30	83.60			1973	85034
		3.40			117.0	2.999	1.503	CT	1.554	1.47	89.70			1973	85034
		2.25			117.0	3.002	1.500	CT	1.539	1.05	76.00			1973	85034
		5.62			118.0	3.004	1.499	CT	1.540	1.46	90.30			1973	85034
		2.25			118.0	2.999	1.499	CT	1.526	1.19	81.30			1973	85034
		5.62			119.0	3.008	1.497	CT	1.538	1.46	90.90			1973	85034
		2.20			119.0	3.007	1.498	CT	1.563	1.49	91.90			1973	85857
		2.20			119.0	3.005	1.500	CT	1.552	1.36	87.80			1973	85857
		3.40			119.0	3.002	1.501	CT	1.533	1.39	88.90			1973	85034
		2.20			120.0	3.006	1.505	CT	1.581	1.41	90.10			1973	85857
		6.70			121.0	3.000	1.502	CT	1.541	0.96	75.10			1973	85034
		1.20			121.0	3.004	1.376	CT	1.615	1.22	84.40			1973	85857
		1.20			121.0	3.005	1.374	CT	1.588	1.27	86.10			1973	85857

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>1c</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5° (K <sub>1c</sub> /TYS) <sup>a</sup> (in.)	K <sub>1c</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>1c</sub> (Ksi • √in.)	K <sub>1c</sub> MEAN	STAN DEV		
RECRYSTALLIZE ANNEAL - 1700F 4HR FC TO 1400F AT 100F/HR COOL TO 800F IN .75HR Cont'd	Forging Cont'd	1.20	R.T. Cont'd	L-T Cont'd	121.0	3.010	1.345	CT	1.556	1.15	82.10	Cont'd	Cont'd	1973	85857
		6.70			121.0	3.001	1.500	CT	1.548	1.06	78.70			1973	85034
		2.20			121.0	3.003	1.502	CT	1.589	1.17	82.80			1973	85857
		2.20			121.0	3.002	1.504	CT	1.555	1.24	85.10			1973	85857
		2.20			122.0	3.003	1.499	CT	1.633	1.18	83.90			1973	85857
		1.20			122.0	3.009	1.318	CT	1.583	1.12	81.70			1973	85857
		1.50			123.0	2.998	1.417	CT	1.593	0.95	75.70			1973	85034
		1.20			123.0	3.006	1.377	CT	1.605	1.17	84.30			1973	85857
		1.50			123.0	3.002	1.377	CT	1.578	0.80	73.20			1973	85034
		2.20			124.0	3.003	1.501	CT	1.607	1.16	84.40			1973	85857
		1.50			124.0	3.004	1.409	CT	1.677	0.94	76.00			1973	85034
		3.20			124.0	3.001	1.504	CT	1.583	1.49	95.70			1973	85857
		1.50			124.0	2.999	1.397	CT	1.585	0.98	77.80			1973	85034
		2.50			124.0	3.005	1.504	CT	1.549	1.08	81.50			1973	85034
		1.20			125.0	3.001	1.375	CT	1.612	1.14	84.60			1973	85857
		2.20			126.0	3.003	1.495	CT	1.591	1.11	83.80			1973	85857
		1.50			127.0	3.001	1.248	CT	1.542	1.17	86.70			1973	85857
		1.50			127.0	3.003	1.250	CT	1.527	1.24	89.50			1973	85857
		1.50			127.0	3.001	1.250	CT	1.583	1.20	88.00			1973	85857
		1.50			128.0	2.999	1.248	CT	1.588	1.07	84.40			1973	85857
		1.50			129.0	2.999	1.249	CT	1.440	1.08	84.80			1973	85857
		1.50			130.0	3.002	1.372	CT	1.560	0.92	78.80			1973	85034

TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5° (K <sub>Ic</sub> ) <sub>TYS</sub> <sup>a</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksi) √(in.)	K <sub>Ic</sub> MEAN	STAN DEV		
RECRYSTALLIZE ANNEAL - 1700F 4HR FC TO 1400F AT 100F/HR COOL TO 900F IN .75HR	Forging	---	R.T.	T.L.	---	3.500	1.750	CT	---	1.31	87.00	83.9	6.9	1974	89004 (1)
		---			---	3.000	1.500	CT	---	1.03	77.00			1974	89004 (1)
		---			---	3.000	1.500	CT	---	0.85	70.00			1974	89004 (1)
		---			---	3.500	1.750	CT	---	1.40	90.00			1974	89004 (1)
		3.40			116.0	3.000	1.502	CT	1.544	1.36	85.70			1973	85034
		5.62			117.0	3.001	1.500	CT	1.537	1.24	82.50			1973	85034
		6.70			118.0	2.997	1.501	CT	1.578	1.32	85.80			1973	85034
		3.40			119.0	3.002	1.500	CT	1.545	1.27	84.90			1973	85034
		5.62			119.0	3.001	1.500	CT	1.543	1.18	81.80			1973	85034
		3.50			120.0	3.007	1.502	CT	1.574	1.35	88.40			1973	85857
		5.62			120.0	2.997	1.499	CT	1.518	1.03	77.00			1973	85034
		5.62			120.0	3.005	1.498	CT	1.520	1.25	84.70			1973	85034
		1.50			121.0	3.004	1.250	CT	1.573	1.11	80.20			1973	85857
		6.70			121.0	3.002	1.500	CT	1.546	0.81	69.80			1973	85034
		1.50			122.0	3.000	1.245	CT	1.475	1.20	84.80			1973	85857
		1.50			122.0	3.000	1.248	CT	1.547	0.96	75.50			1973	85857
		3.40			123.0	2.998	1.497	CT	1.493	0.82	70.40			1973	85034
		6.70			123.0	3.000	1.501	CT	1.544	1.33	89.60			1973	85034
		4.75			123.0	3.004	1.502	CT	1.558	1.11	82.00			1973	85034
		3.50			123.0	2.998	1.500	CT	1.530	1.32	89.20			1973	85034
		2.20			124.0	3.002	1.502	CT	1.572	1.24	87.30			1973	85857
		6.70			124.0	2.996	1.502	CT	1.501	1.12	83.00			1973	85034

NOTES: (1) TYS APPROX. 120



TABLE 6.16.2.1 (CONTINUED)

TITANIUM Ti-6Al-4V K <sub>1c</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5° (K <sub>1c</sub> /√Ys) <sup>a</sup> (in.)	K <sub>1c</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>1c</sub> (Ksi • √in.)	K <sub>1c</sub> MEAN	STAN DEV		
RECRYSTALLIZE ANNEAL - 1700F 4HR FC TO 1400F AT 100F/HR COOL TO 800F IN .75HR Cont'd	Forging Cont'd	4.75	R.T. Cont'd	T-L Cont'd	125.0	3.001	1.502	CT	1.541	1.24	87.90	Cont'd	Cont'd	1973	85034
		2.20			125.0	3.006	1.498	CT	1.593	1.03	80.30			1973	85857
		3.20			126.0	3.000	1.508	CT	1.589	1.30	90.70			1973	85857
		2.25			125.0	2.998	1.500	CT	1.516	1.02	80.50			1973	85034
		2.25			126.0	2.995	1.502	CT	1.535	1.31	91.30			1973	85034
		3.20			126.0	3.000	1.501	CT	1.521	1.47	96.50			1973	85857
		2.20			127.0	3.008	1.502	CT	1.783	1.38	94.40			1973	85857
		2.20			127.0	3.002	1.500	CT	1.577	1.03	81.40			1973	85857
		2.25			127.0	3.001	1.500	CT	1.552	1.34	93.10			1973	85034
		2.20			128.0	3.006	1.500	CT	1.601	0.88	75.90			1973	85857
		1.50			128.0	3.002	1.398	CT	1.595	0.97	79.70			1973	85034
		1.50			128.0	3.003	1.424	CT	1.583	0.83	74.20			1973	85034
		1.50			129.0	3.001	1.377	CT	1.575	0.85	75.40			1973	85034
		1.50			129.0	3.000	1.387	CT	1.588	1.02	82.20			1973	85034
		1.50			129.0	2.999	1.355	CT	1.586	1.11	85.90			1973	85034
		1.50			130.0	3.001	1.368	CT	1.584	1.16	88.50			1973	85034
		1.20			130.0	3.004	1.347	CT	1.587	1.26	92.50			1973	85857
		1.50			130.0	3.004	1.399	CT	1.587	0.99	81.70			1973	85034
		1.20			130.0	3.008	1.344	CT	1.653	1.27	92.50			1973	85857
		2.25			130.0	3.000	1.500	CT	1.522	1.32	94.50			1973	85034
		1.20			130.0	3.010	1.319	CT	1.649	1.22	90.80			1973	85857
		2.20			131.0	3.006	1.497	CT	1.592	0.95	80.50			1973	85857

TABLE 6.16.2.1 (CONCLUDED)

23 of 23

Ti-6Al-4V

TITANIUM Ti-6Al-4V K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (ksi)	SPECIMEN			CRACK LENGTH (in.) A	ΔK <sub>ITS</sub> <sup>a</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (ksi√in.)	K <sub>Ic</sub> MEAN	STAN DEV		
RECRYSTALLIZE ANNEAL - 1700F 4HR FC TO 1400F AT 100F/HR COOL TO 900F IN .75HR Cont'd	Forging Cont'd	1.20	R.T. Cont'd	T-L Cont'd	131.0	3.005	1.375	CT	1.599	0.85	76.30	Cont'd	Cont'd	1973	85857
		1.50			132.0	3.000	1.409	CT	1.583	0.81	75.00			1973	85034
		1.20			133.0	3.008	1.374	CT	1.577	0.86	77.90			1973	85857
		1.20			134.0	3.009	1.380	CT	1.625	1.15	91.00			1973	85857
		2.25			134.0	2.998	1.499	CT	1.537	1.04	86.50			1973	85034
		1.20			136.0	3.007	1.377	CT	1.585	1.08	89.60			1973	85857
		--			--	3.000	1.500	CT	--	1.20	83.00			1974	89004 (1)
		4.60			118.0	3.003	1.428	CT	1.559	1.42	89.30			1973	85634
		6.70			121.0	3.001	1.502	CT	1.552	1.46	92.50			1973	85034
		4.75			122.0	3.000	1.500	CT	1.573	1.37	90.20			1973	85034
RECRYSTALLIZE ANNEAL - 1700F 4HR FC TO 1400F AT 100F/HR COOL TO 900F IN .75HR	Forging	6.70	R.T.	S-L	122.0	3.000	1.502	CT	1.540	1.40	91.10	88.9	3.2	1973	85034
		4.60			122.0	3.001	1.500	CT	1.540	1.26	86.70			1973	85634
		6.70			122.0	2.999	1.501	CT	1.532	1.37	90.40			1973	85034
		4.75			124.0	3.002	1.502	CT	1.544	1.37	91.70			1973	85034
		6.70			125.0	3.001	1.501	CT	1.543	1.17	85.60			1973	85034
		0.62			160.0	3.503	0.634	CT	1.801	0.18	43.50			1973	85836
		0.62			160.0	3.501	0.632	CT	1.790	0.19	44.00			1973	85836
		0.62			160.0	3.503	0.633	CT	1.831	0.16	40.30			1973	85836
		2.00			--	--	2.000	--	--	1.32	92.32			--	R1005
		2.00			--	--	2.000	--	--	1.00	83.52			--	R1005
STA	Plate	0.62	R.T.	T-L	160.0	3.501	0.632	CT	1.790	0.19	44.00	42.6	2.0	1973	85836
		0.62			160.0	3.503	0.633	CT	1.831	0.16	40.30			1973	85836
STA	Forging	2.00	R.T.	--	126.9	--	2.000	--	--	1.32	92.32	--	--	--	R1005
STOA	Forging	2.00	R.T.	--	132.0	--	2.000	--	--	1.00	83.52	--	--	--	R1005
STOA 1750F 1 HR WQ 1300F 2 HR AC	Forging	2.50	R.T.	--	142.0	2.000	1.000	CT	1.000	0.44	59.80	59.4	2.3	1974	88962
		2.50			142.0	2.000	1.000	CT	1.000	0.47	61.40			1974	88962
		2.50			142.0	2.000	1.000	CT	1.000	0.40	56.90			1974	88962

NOTES: (1) TYS APPROX. 120

TABLE 6.16.2.2

TI-6AL-4V K <sub>C</sub>																				
CONDITION HEAT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>			K <sub>C</sub>		DATE	REFER		
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>y</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi√in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi√in.)	K <sub>C</sub> MEAN			STAN DEV	
BUCKLING OF CRACK EDGES NOT RESTRAINED																				
1300F 1HR AC	Forging	---	R.T.	L-T	147.1	5.970	0.382	2.020	3.180	---	51.90	99.57	141.72	---	---	---	1964	58782		
		---			147.1	5.970	0.382	2.020	3.200	---	53.50	102.64	101.1	2.2	144.4	3.7	---	58782		
1300F 1HR AC	Forging	---	R.T.	L-T	147.1	8.970	0.732	3.000	5.000	---	54.40	126.94	190.38*	---	---	---	1964	58782		
1300F 1HR AC	Forging	---	R.T.	L-T	147.1	8.970	0.998	3.000	5.200	---	29.30	66.05	103.28	---	---	---	1964	58782		
BUCKLING OF CRACK EDGES RESTRAINED																				
ANNEALED	Sheet	0.04	-109	L-T	163.0	8.000	0.040	2.000	---	---	73.60	135.72	---	7.0	121.4	---	---	---	1963	54304
		0.04			163.0	8.000	0.040	1.040	---	---	94.10	121.54	---				---	---	1963	54304
		0.04			163.0	8.000	0.040	0.850	---	---	101.00	117.52	---				---	---	1963	54304
		0.04			163.0	8.000	0.040	1.540	---	---	77.20	122.89	---				---	---	1963	54304
		0.04			163.0	8.000	0.040	3.060	---	---	47.40	114.42	---				---	---	1963	54304
		0.04			163.0	8.000	0.040	4.840	---	---	33.60	121.50	---				---	---	1963	54304
		0.04			163.0	8.000	0.040	4.440	---	---	35.30	116.22	---				---	---	1963	54304
		0.04			137.3	8.000	0.040	1.550	---	---	95.50	152.56*	---				---	---	1963	54304
ANNEALED	Sheet	0.04	R.T.	L-T	137.3	8.000	0.040	3.030	---	---	61.20	146.71	4.3	143.2	---	---	---	1963	54304	
		0.04			137.3	8.000	0.040	2.020	---	---	78.60	145.78				---	---	---	1963	54304
		0.04			137.3	8.000	0.040	0.950	---	---	108.30	133.46*				---	---	---	1963	54304
		0.04			137.3	8.000	0.040	4.050	---	---	47.50	143.18				---	---	---	1963	54304

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.

TABLE 6.16.2.2 (CONTINUED)

TI-6AL-4V K <sub>C</sub>																			
CONDITION HEAT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>			K <sub>C</sub>		DATE	REFER	
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>y</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi/in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi/in.)	K <sub>C</sub> MEAN			STAN DEV
BUCKLING OF CRACK EDGES RESTRAINED																			
ANNEALED Cont'd	Sheet Cont'd	0.04	R.T. Cont'd	L-T Cont'd	137.3	8.000	0.040	5.030	---	---	36.20	137.12	---	---	---	Cont'd	---	1963	54304
		0.04			137.3	8.000	0.040	0.480	---	---	126.00	109.65*	Cont'd	---	---	Cont'd	---	1963	54304
	Sheet	0.04	550	L-T	96.7	8.000	0.040	2.020	---	---	80.50	149.31*	---	---	---	---	---	1963	54304
		0.04			96.7	8.000	0.040	1.280	---	---	91.00	130.02*	---	---	---	---	---	1963	54304
ANNEALED	Sheet	0.04	550	L-T	96.7	8.000	0.040	0.570	---	---	101.20	96.06*	---	---	---	---	---	1963	54304
		0.04			96.7	8.000	0.040	0.950	---	---	94.90	116.96*	---	---	---	---	---	1963	54304
	Sheet	0.04	550	L-T	96.7	8.000	0.040	0.250	---	---	111.20	69.73*	---	---	---	---	---	1963	54304
		0.04			96.7	8.000	0.040	0.250	---	---	111.20	69.73*	---	---	---	---	---	---	1963
BUCKLING OF CRACK EDGES UNKNOWN																			
MA	Plate	0.25	R.T.	L-T	130.0	9.630	0.280	3.800	5.220	25.60	51.70	140.00	---	---	182.38*	---	---	1971	83984
MA	Plate	0.25	R.T.	L-T	130.0	9.630	0.286	5.780	6.860	18.70	37.80	148.60	---	---	187.79*	---	---	1971	83984
MA	Plate	0.25	R.T.	L-T	130.0	9.630	0.293	1.920	---	36.50	85.10	151.52*	---	---	---	---	---	1971	83984
MA	Plate	0.25	R.T.	L-T	130.0	16.120	0.260	8.020	10.580	31.30	45.10	189.99	---	---	256.46*	---	---	1971	83984
MA	Plate	0.25	R.T.	L-T	130.0	16.120	0.275	3.990	6.100	31.10	67.50	175.67	---	---	229.66*	---	---	1971	83984
MA	Plate	0.25	R.T.	L-T	130.0	16.110	0.285	12.93	13.550	11.30	15.40	125.65	---	---	---	---	---	1971	83984
MA	Plate	0.25	R.T.	L-T	130.0	18.000	0.265	4.540	---	53.90	75.30	209.36	---	---	---	---	---	1971	83984
		0.25			130.0	18.000	0.265	4.640	---	35.60	75.40	212.33	210.8	2.1	---	---	---	1971	83984
MA	Plate	0.25	R.T.	L-T	130.0	32.160	0.262	6.020	---	39.20	75.20	236.38	---	---	---	---	---	1971	83984

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.

TABLE 6.16.2.2 (CONTINUED)

TI-6AL-4V K <sub>C</sub>																				
CONDITION HEAT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>				K <sub>C</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>s</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>CT</sub> (Ksi√in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi√in.)	K <sub>C</sub> MEAN	STAN DEV			
BUCKLING OF CRACK EDGES UNKNOWN																				
MA	Plate	0.25			130.0	32.150	0.270	12.72	17.000	33.40	47.00	233.00			295.74				1971	83984
		0.25		R.T.	L-T	130.0	32.140	0.273	19.20	21.700	14.20	26.20	187.15		212.5	23.3	218.88	54.3	1971	83984
		0.25				130.0	32.130	0.275	8.010	---	30.60	58.90	217.31				---		1971	83984
MA	Plate	0.25	R.T.	L-T	130.0	32.160	0.288	8.070	---	40.20	55.40	205.27	---			---	---	---	1971	83984
BUCKLING OF CRACK EDGES RESTRAINED																				
MA	Sheet	0.05			136.5	24.070	0.047	10.00	---	---	41.60	184.97							1964	57573
		0.05			133.8	24.020	0.048	6.000	6.550	51.80	52.10	166.39				175.22			1964	57573
		0.05			136.5	23.900	0.049	5.990	---	---	47.30	150.98				---			1964	57573
		0.05			136.5	24.060	0.049	6.000	10.500	43.60	49.60	158.39				228.95			1964	57573
		0.05			136.5	24.060	0.049	6.000	---	---	60.70	193.83				---			1964	57573
		0.05			136.5	23.990	0.050	6.000	---	---	47.50	151.72				---			1964	57573
		0.05			133.8	24.050	0.050	6.000	---	41.30	51.50	164.46				---			1964	57573
		0.05		R.T.	L-T	136.5	24.060	0.050	3.000	---	---	78.80	172.72	167.0	12.8		196.4	19.9	1964	57573
		0.05			136.5	24.070	0.050	6.000	---	---	56.60	180.74				---			1964	57573
		0.05			136.7	24.070	0.050	6.000	---	---	53.20	169.88				---			1964	57573
		0.05			136.7	24.070	0.052	6.010	7.350	41.10	51.80	165.57				186.87			1964	57573
		0.05			136.7	24.070	0.052	6.010	8.760	43.80	51.40	164.29				207.75			1964	57573
		0.05			136.0	24.080	0.054	6.000	8.120	38.40	47.00	150.08				180.69			1964	57573
		0.05			136.0	24.080	0.055	6.010	8.170	45.90	51.50	164.60				198.79			1964	57573

TABLE 6.16.2.2 (CONCLUDED)

TI-6AL-4V    K <sub>C</sub>																			
CONDITION HEAT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>			K <sub>C</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>0</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>0</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi√in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi√in.)	K <sub>C</sub> MEAN	STAN DEV		
BUCKLING OF CRACK EDGES RESTRAINED																			
MA	Sheet	0.20			129.3	24.060	0.212	6.000	---	---	81.00	258.66*			---			1964	57573
		0.20	R.T.	L-T	129.3	24.070	0.212	3.010	---	---	93.10	204.41*			---		---	1964	57573
		0.20			129.3	24.070	0.212	6.010	---	65.60	70.60	225.66			---		---	1964	57573
MA	Sheet	0.20			129.3	24.070	0.218	6.000	---	---	76.40	243.96			---			1964	57573
		0.20	R.T.	L-T	129.3	24.080	0.220	10.00	---	---	55.30	245.86	244.9	1.3	---		---	1964	57573
MA	Sheet	0.05	R.T.	L-T	136.7	24.370	0.062	5.990	---	---	54.20	172.73	---	---	---		---	1964	57573
MA	Sheet	0.05	82	L-T	136.5	24.070	0.061	5.990	7.100	43.30	47.50	151.53	---	---	167.72	---		1964	57573
MA	Sheet	0.05			163.3	8.000	0.060	1.980	3.130	35.00	84.70	155.28			207.78*			1964	57573
		0.05	-110	T-L	163.3	8.010	0.060	1.970	2.540	72.50	77.30	141.29			164.74	159.4	7.5	1964	57573
		0.05			164.3	8.010	0.062	1.920	2.370	66.60	75.50	135.97	144.2	10.0	154.07			1964	57573
MA	Sheet	0.03	R.T.	T-L	127.0	8.040	0.025	1.980	2.600	61.20	75.60	138.54	---	---	163.45*	---		1964	57573
MA	Sheet	0.05	R.T.	T-L	136.0	8.010	0.062	2.000	2.220	90.00	95.30	175.72*	---	---	186.89*	---		1964	57573
MA	Sheet	0.13	R.T.	T-L	139.7	8.060	0.127	1.980	2.740	48.00	103.70	190.02*	---	---	231.93*	---		1964	57573
MA	Sheet	0.03	650	T-L	80.2	8.030	0.025	2.060	2.460	75.70	77.70	145.73*	---	---	162.23*	---		1964	57573
MA	Sheet	0.05	650	T-L	81.7	8.020	0.061	2.000	2.090	63.40	75.40	139.01*	---	---	142.64*	---		1964	57573

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.

R

Ti-6Al-4V

Condition/Ht:

Form:

Specimen Type:

Orientation:

Frequency: 30 Hz

Environment: LAB AIR; RT

Yield Strength:

Ult. Strength:

Specimen Thk: 0.081 in.

Specimen Width: 2.5 in.

Ref: PW003

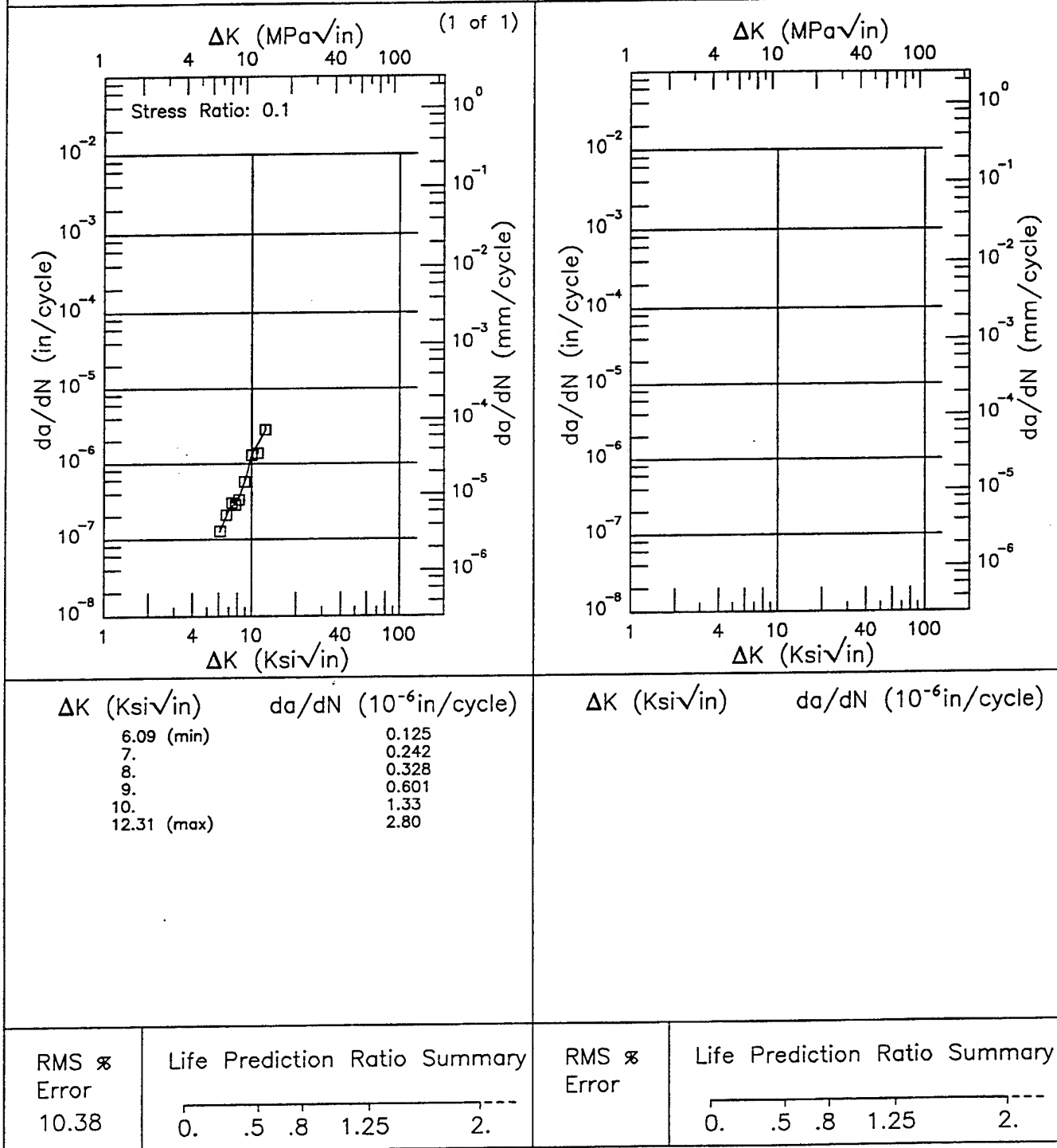


Figure 6.16.3.1.1

**This page intentionally left blank**



R

Ti-6Al-4V

Condition/Ht:

Form:

Specimen Type: CT

Orientation: C-R

Frequency: 20 Hz

Environment: LAB AIR; RT

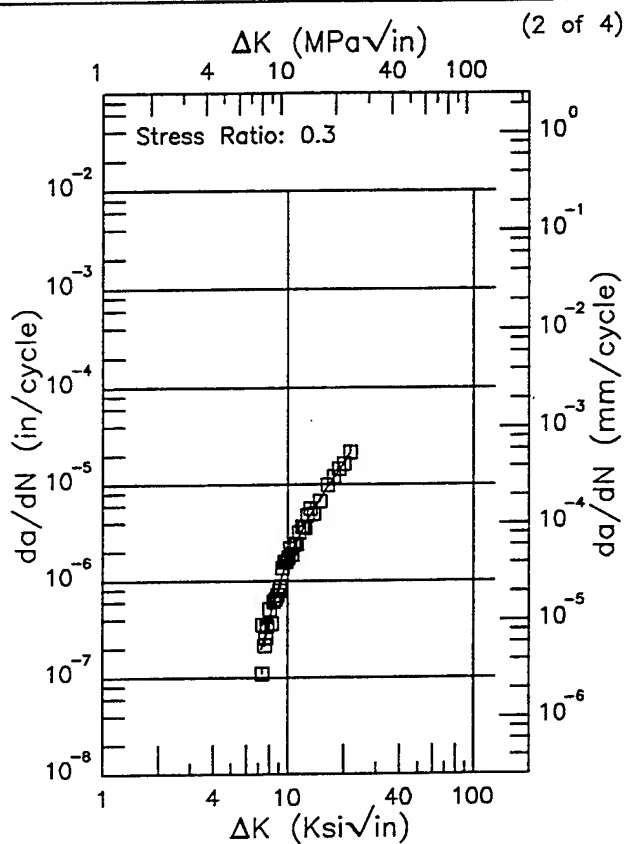
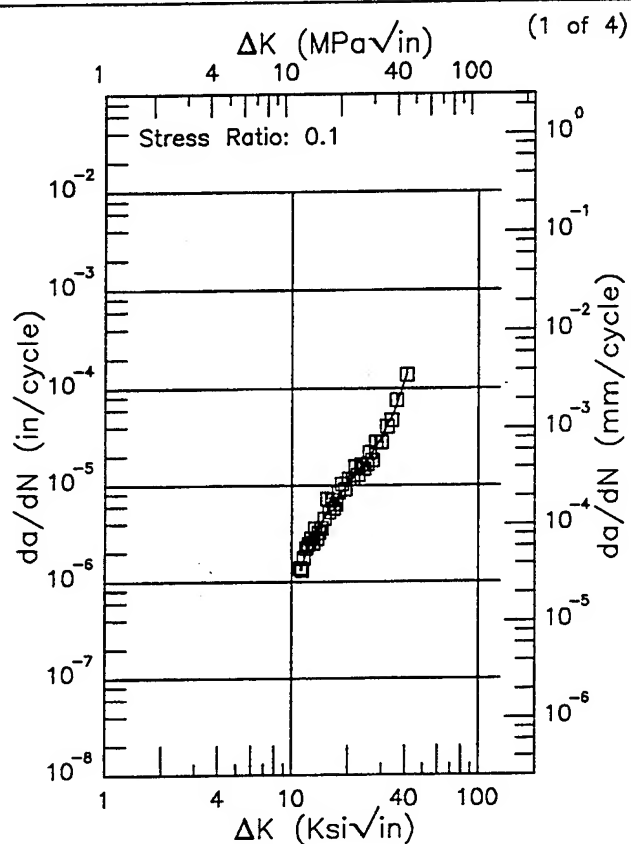
Yield Strength:

Ult. Strength:

Specimen Thk: 0.28 - 0.299 in.

Specimen Width: 2.5 in.

Ref: PW003



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
11.07 (min)	1.31
13.	2.86
16.	5.86
20.	10.4
25.	17.8
30.	31.2
35.	58.9
40.	121.
41.03 (max)	142.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
7.27 (min)	0.198
8.	0.403
9.	0.898
10.	1.66
13.	4.48
16.	8.73
20.	16.3
21.70 (max)	21.2

RMS %  
Error  
12.87

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
17.18

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.16.3.1.2

Condition/Ht:  
Form:  
Specimen Type: CT  
Orientation: C-R  
Frequency: 20 Hz  
Environment: LAB AIR; RT

Yield Strength:  
Ult. Strength:  
Specimen Thk: 0.28 - 0.299 in.  
Specimen Width: 2.5 in.  
Ref: PW003

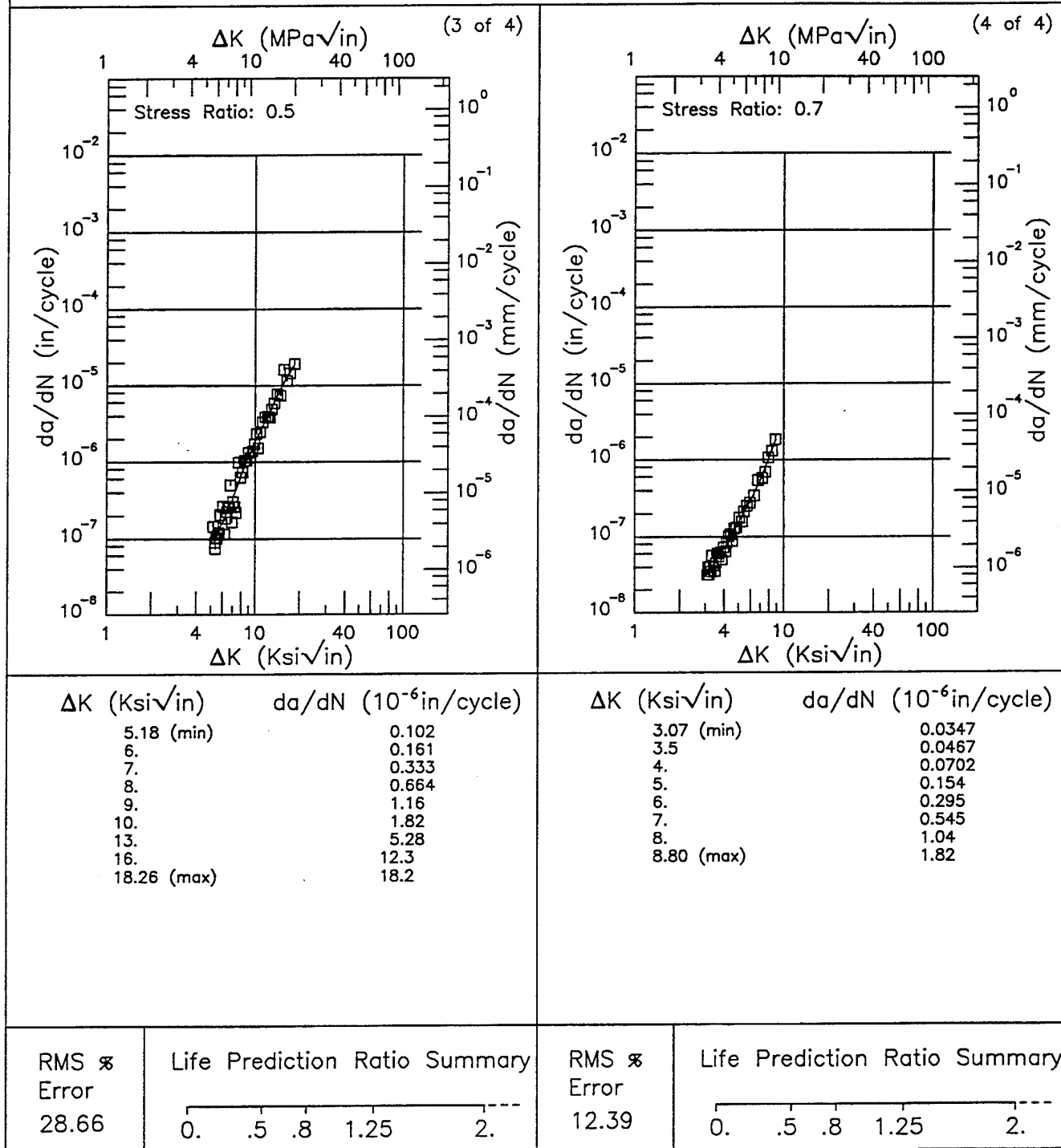
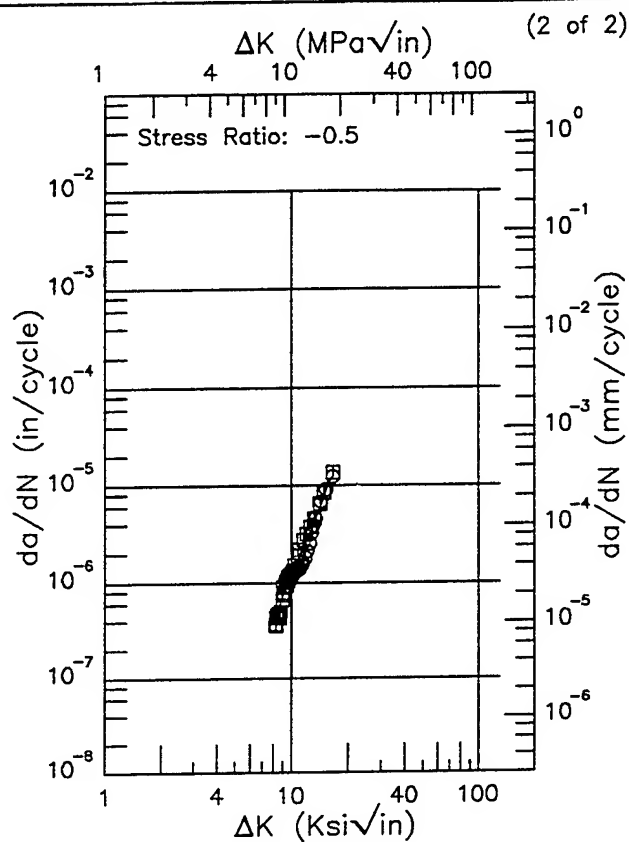
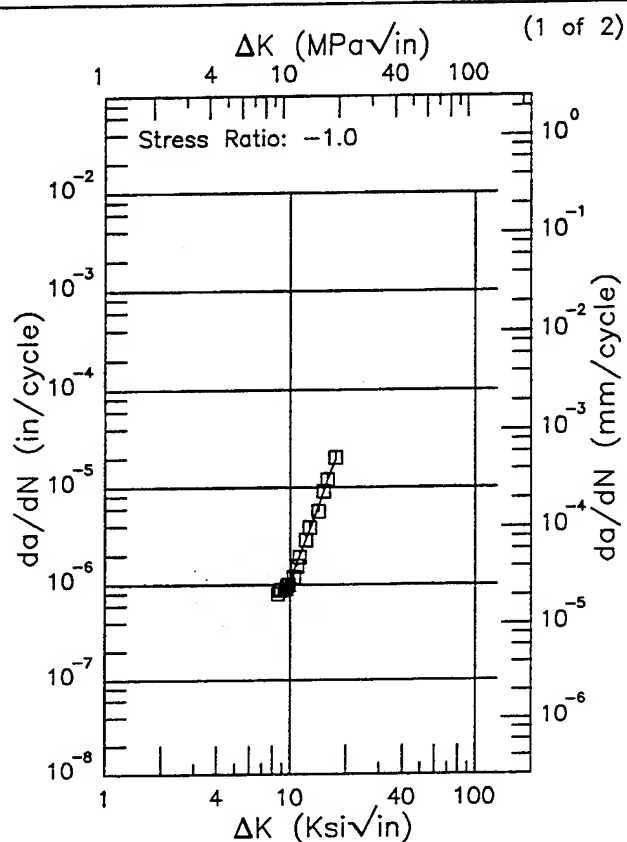


Figure 6.16.3.1.2 (Concluded)

R | Ti-6Al-4V |  
 Condition/Ht:  
 Form:  
 Specimen Type: CCP (max load specified)  
 Orientation: C-R  
 Frequency: 0.2 Hz  
 Environment: LAB AIR; RT

Yield Strength:  
 Ult. Strength:  
 Specimen Thk: 0.299 - 0.301 in.  
 Specimen Width: 2.5 in.  
 Ref: PW003



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
8.55 (min)	0.783
9.	0.847
10.	1.14
13.	3.96
16.	12.5
17.54 (max)	19.7

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
8.19 (min)	0.314
9.	0.783
10.	1.21
13.	3.67
16.	11.1
16.57 (max)	12.2

RMS %  
 Error  
 6.59

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

RMS %  
 Error  
 15.36

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

Figure 6.16.3.1.3

Condition/Ht:

Form:

Specimen Type: CCP (max load specified)

Orientation: C-R

Frequency: 0.2 Hz

Environment: LAB AIR; 300°F

Yield Strength:

Ult. Strength:

Specimen Thk: 0.297 - 0.302 in.

Specimen Width: 2.5 in.

Ref: PW003

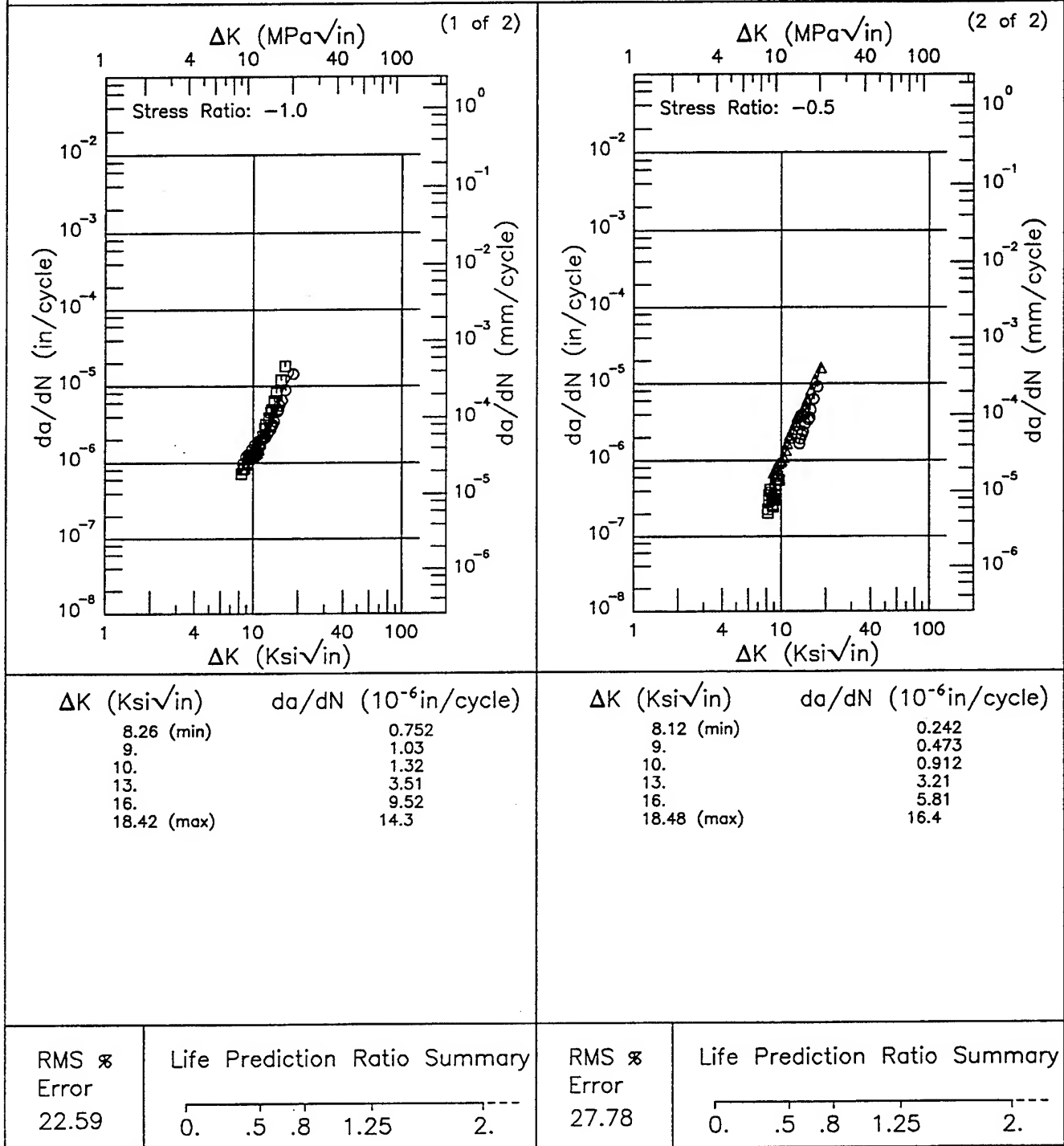
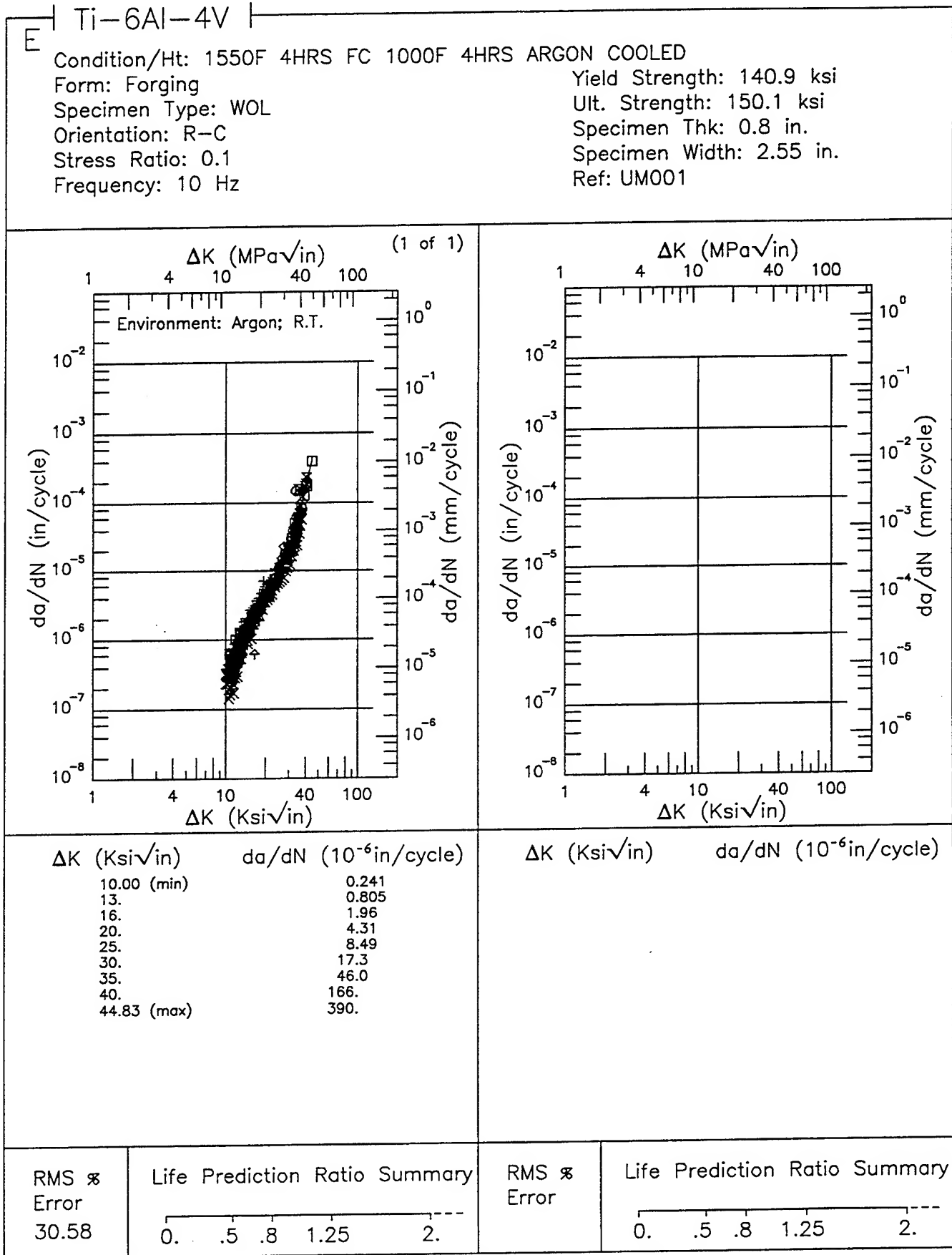


Figure 6.16.3.1.4



**Figure 6.16.3.1.5**

Condition/Ht: 1750F 4HRS ARGON COOLED  
 Form: Forging  
 Specimen Type: WOL  
 Orientation: R-C  
 Stress Ratio: 0.1  
 Frequency: 10 Hz

Yield Strength: 135.7 ksi  
 Ult. Strength: 144.9 ksi  
 Specimen Thk: 0.8 in.  
 Specimen Width: 2.55 in.  
 Ref: UM001

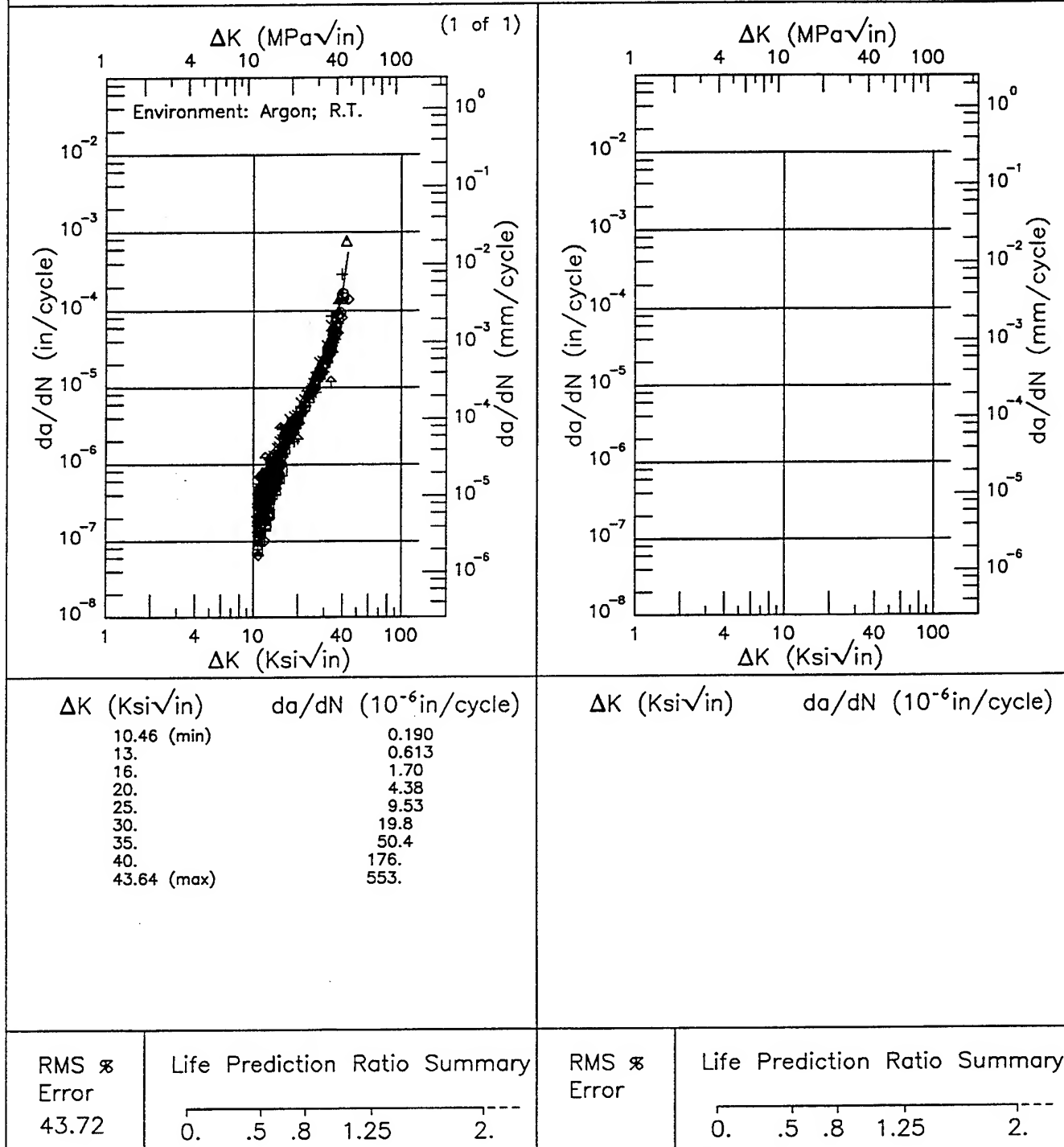
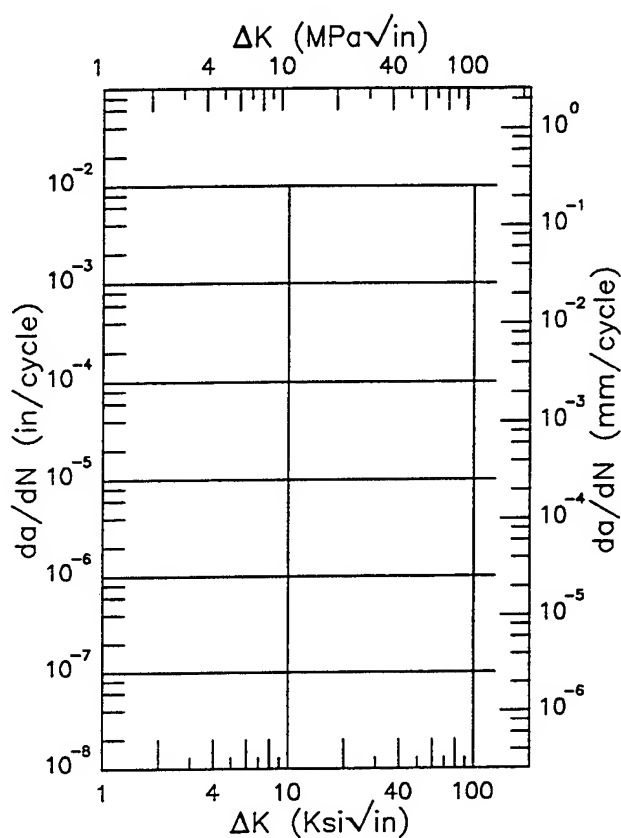
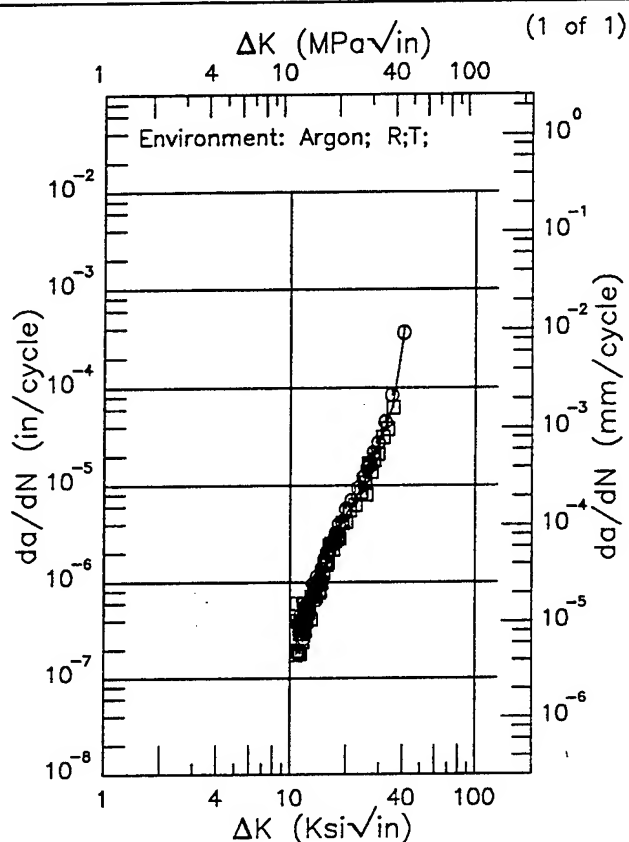


Figure 6.16.3.1.6

E | Ti-6Al-4V |  
 Condition/Ht: 1750F, 4HRS ARGON COOLED  
 Form: Forging  
 Specimen Type: WOL  
 Orientation: C-R  
 Stress Ratio: 0.1  
 Frequency: 10 Hz

Yield Strength: 135.7 ksi  
 Ult. Strength: 144.9 ksi  
 Specimen Thk: 0.8 in.  
 Specimen Width: 2.55 in.  
 Ref: UM001



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
10.71 (min)	0.294
13.	0.615
16.	1.84
20.	5.00
25.	11.1
30.	26.1
35.	63.1
40.	296.
40.42 (max)	360.

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS  $\times$   
 Error  
 21.49

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2. ---

RMS  $\times$   
 Error

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2. ---

Figure 6.16.3.1.7

Ti-6Al-4V

E

Condition/Ht: 1775F 1HR WQ 1675F 1HR WQ 1000F 4HR AC

Form: 0.5 in. Disk

Specimen Type: CCP (max load specified)

Orientation: C-R

Stress Ratio: 0.05

Frequency: 0.3 - 10 Hz

Yield Strength: 120 ksi

Ult. Strength: 130 ksi

Specimen Thk: 0.12 in.

Specimen Width: 1.98 in.

Ref: GE003

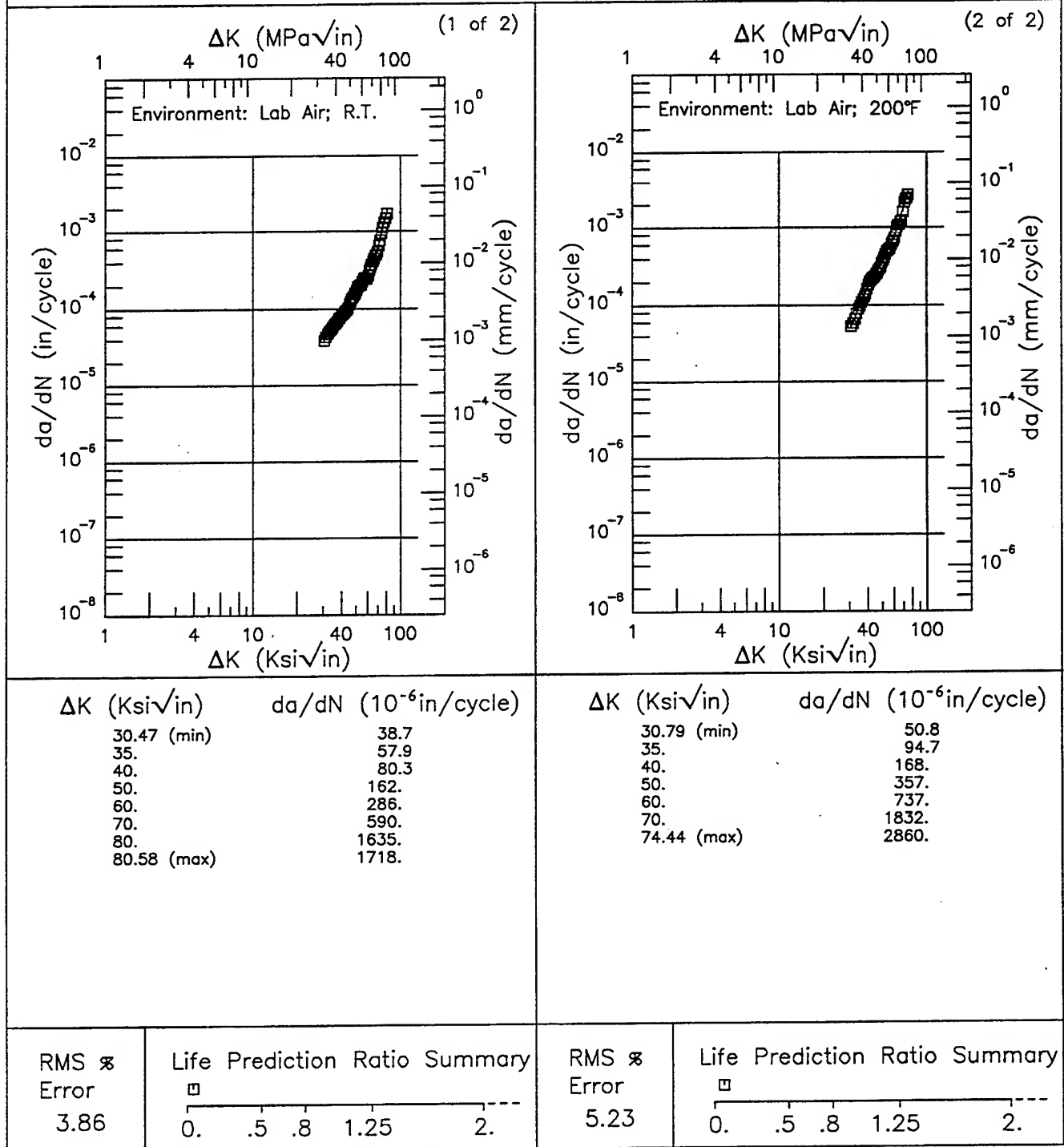


Figure 6.16.3.1.8



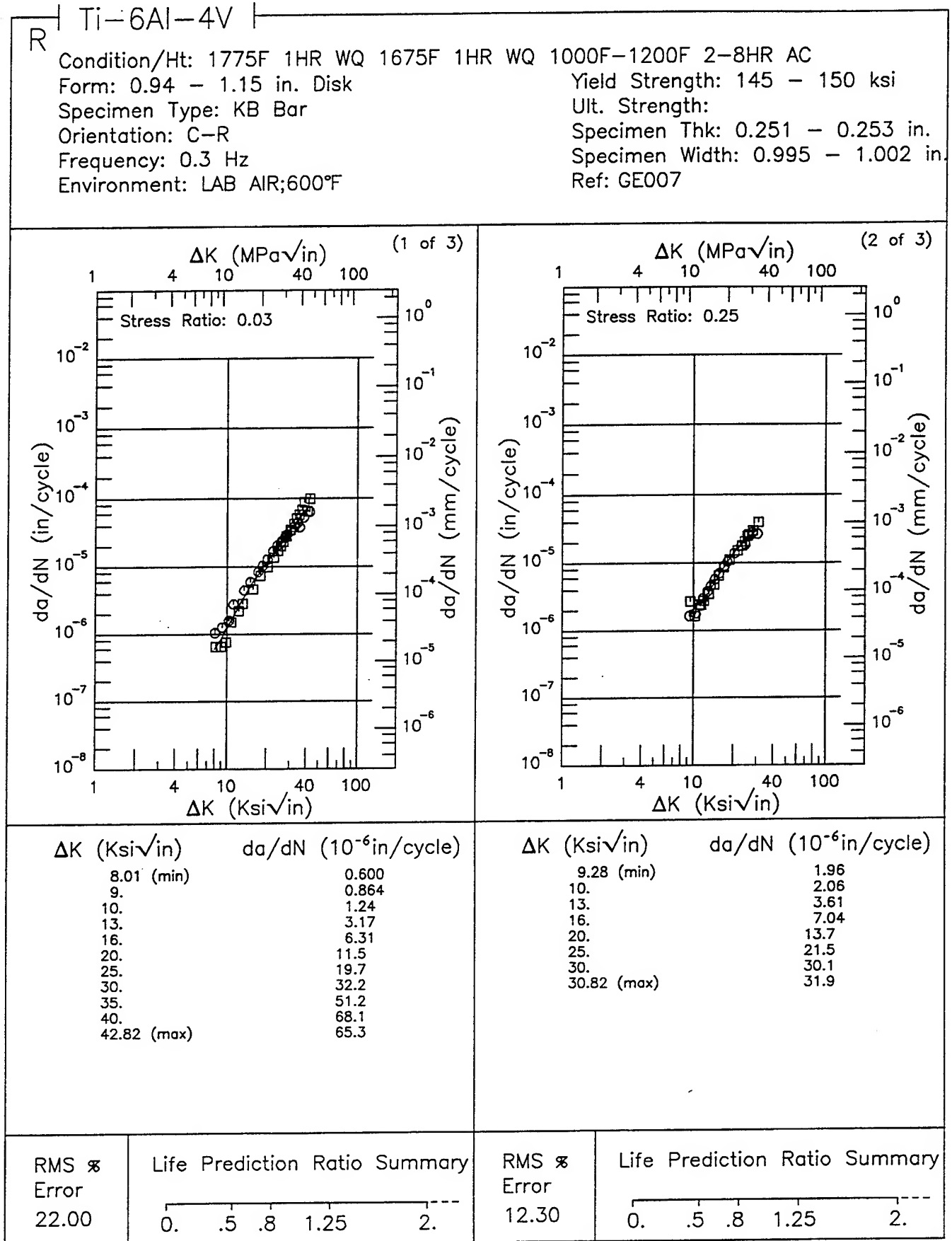
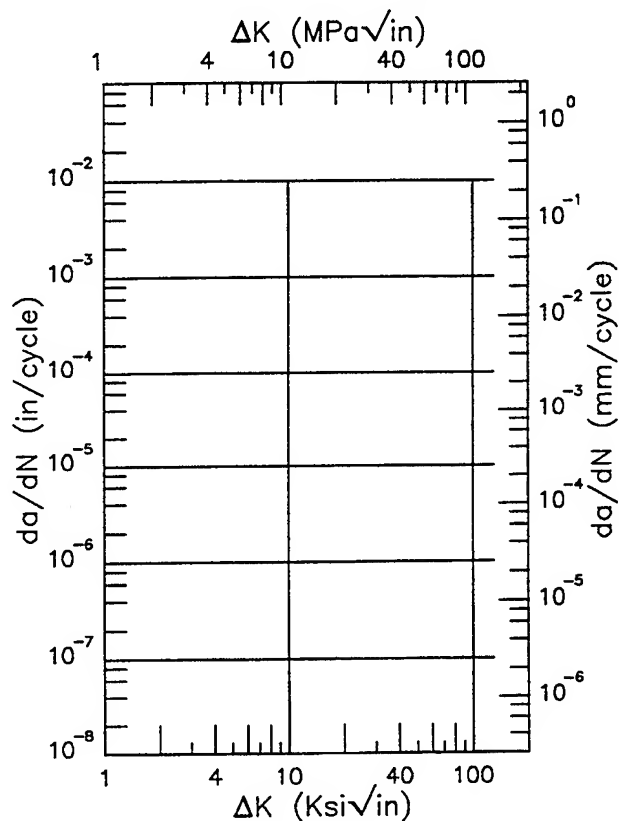
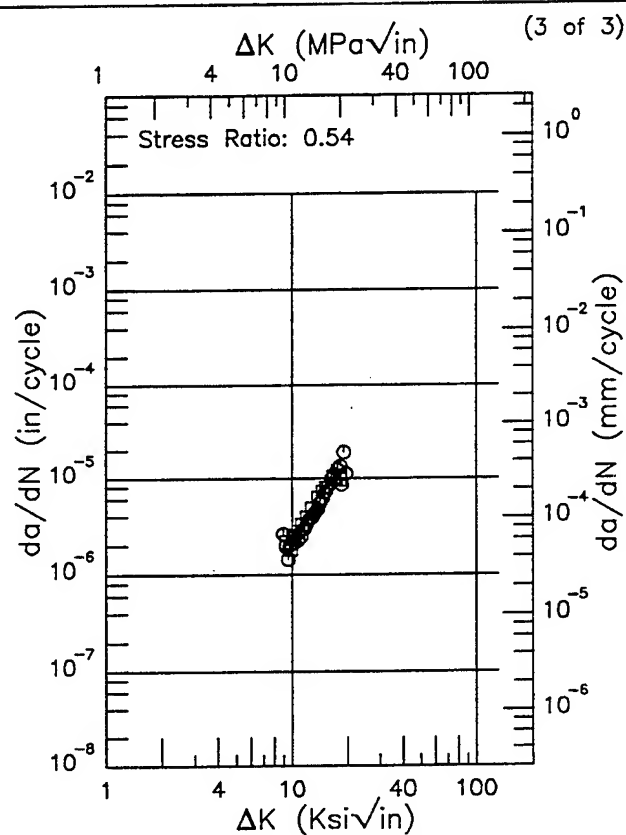


Figure 6.16.3.1.9

Ti-6Al-4V R

Condition/Ht: 1775F 1HR WQ 1675F 1HR WQ 1000F-1200F 2-8HR AC  
 Form: 0.94 - 1.15 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Frequency: 0.3 Hz  
 Environment: LAB AIR;600°F

Yield Strength: 145 - 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.251 - 0.253 in.  
 Specimen Width: 0.995 - 1.002 in.  
 Ref: GE007



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
8.94 (min)	1.96
9.	1.96
10.	2.12
13.	4.38
16.	8.94
19.48 (max)	13.6

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )      da/dN (10<sup>-6</sup>in/cycle)

RMS %  
Error  
14.60

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 6.16.3.1.9 (Concluded)

R

Ti-6Al-4V

Condition/Ht: 1775F 1HR WQ 1675F 1HR WQ 1000F-1200F 2-8HR AC

Form: 0.94 in. Disk

Specimen Type: KB Bar

Orientation: C-R

Frequency: 0.3 Hz

Environment: LAB AIR;300°F

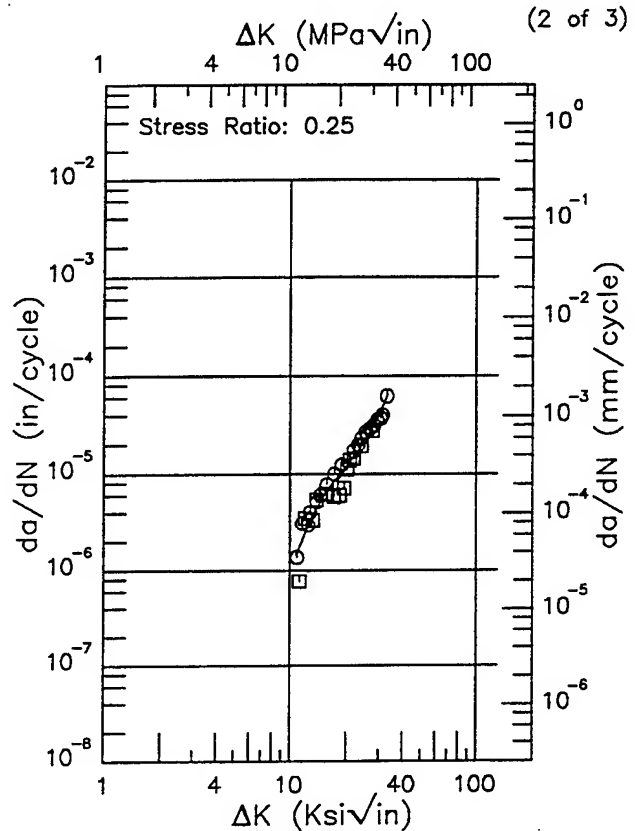
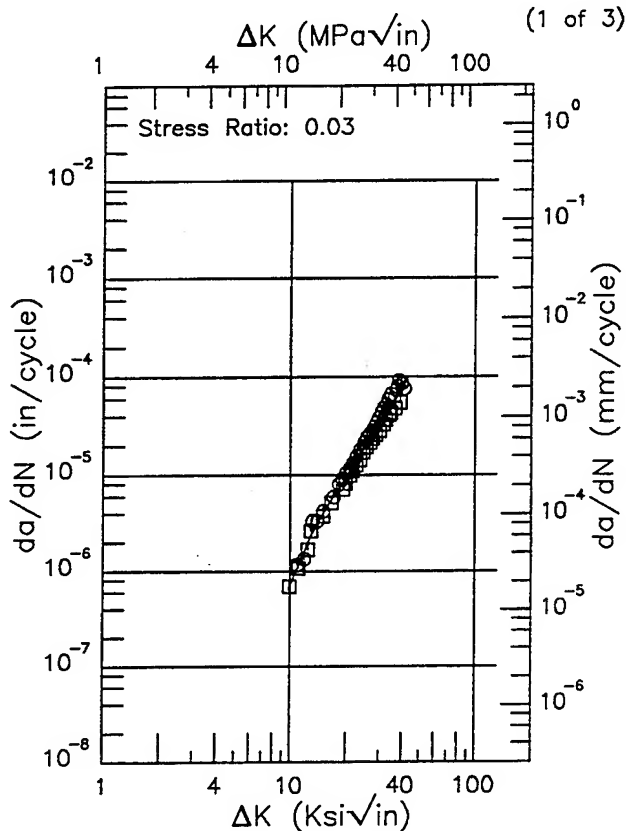
Yield Strength: 150 ksi

Ult. Strength:

Specimen Thk: 0.252 in.

Specimen Width: 0.991 - 0.999 in.

Ref: GE007



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
9.83 (min)	0.644
10.	0.709
13.	2.40
16.	4.92
20.	9.75
25.	19.7
30.	34.6
35.	53.3
40.	76.6
41.12 (max)	82.6

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
10.90 (min)	1.46
13.	3.46
16.	6.88
20.	11.9
25.	20.9
30.	39.8
32.83 (max)	60.4

RMS %  
Error  
14.98

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
22.63

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.16.3.1.10

Ti-6Al-4V R

Condition/Ht: 1775F 1HR WQ 1675F 1HR WQ 1000F-1200F 2-8HR AC  
 Form: 0.94 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Frequency: 0.3 Hz  
 Environment: LAB AIR;300°F  
 Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.252 in.  
 Specimen Width: 0.991 - 0.999 in.  
 Ref: GE007

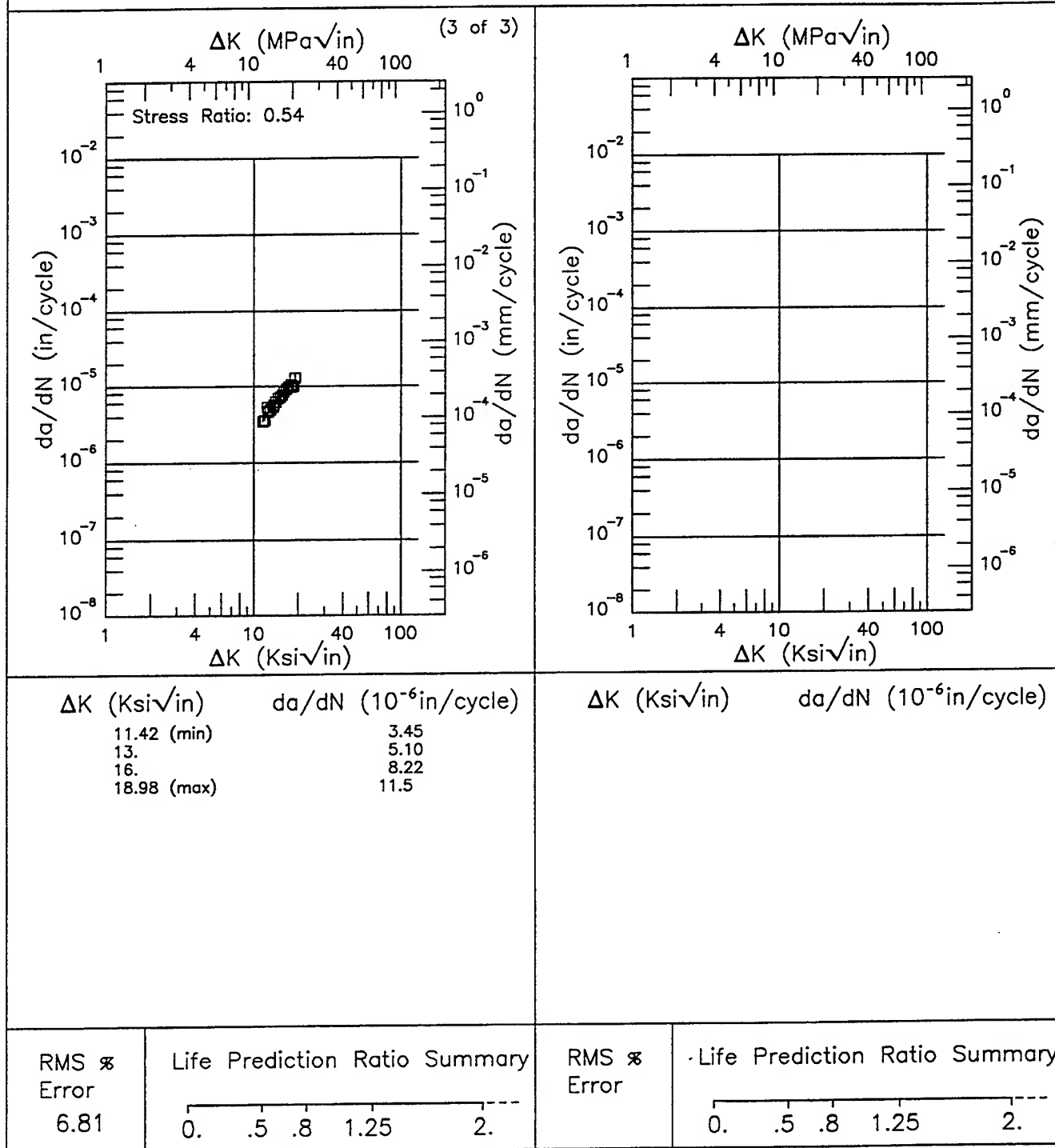
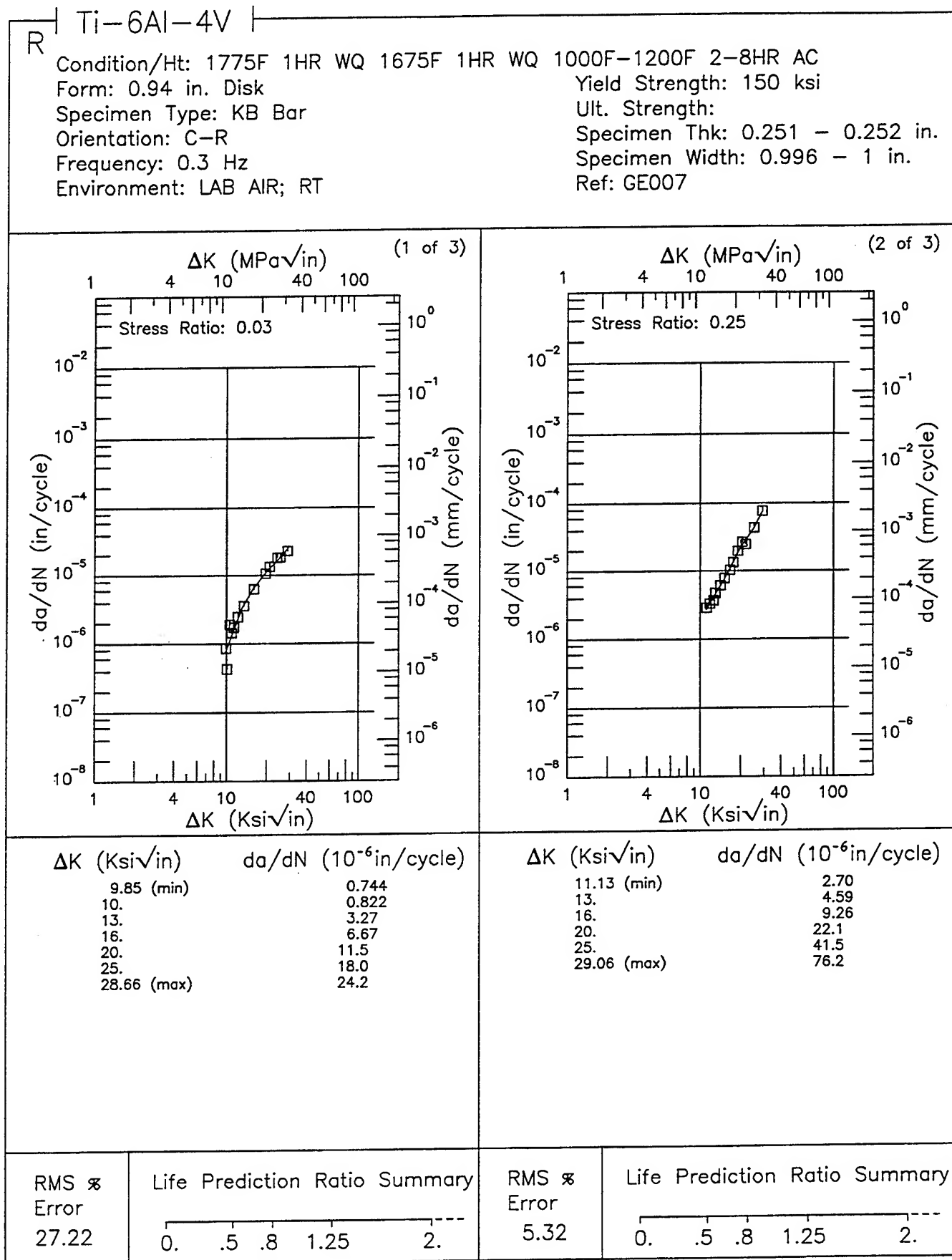


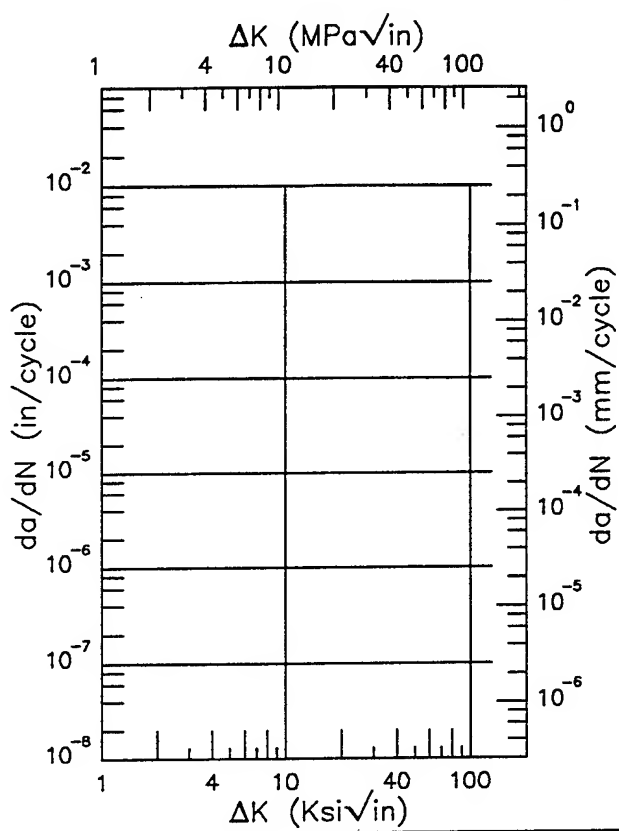
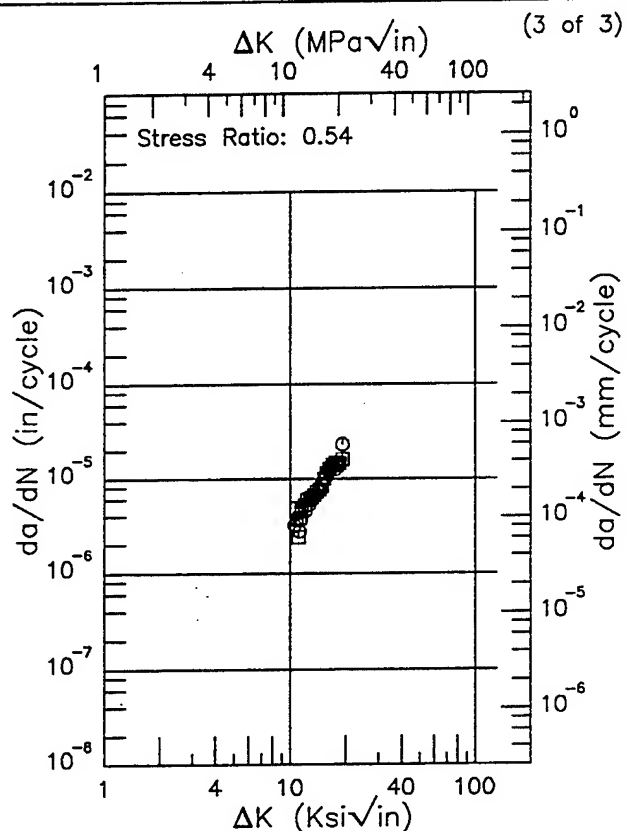
Figure 6.16.3.1.10 (Concluded)



**Figure 6.16.3.1.11**

Condition/Ht: 1775F 1HR WQ 1675F 1HR WQ 1000F-1200F 2-8HR AC  
 Form: 0.94 in. Disk  
 Specimen Type: KB Bar  
 Orientation: C-R  
 Frequency: 0.3 Hz  
 Environment: LAB AIR; RT

Yield Strength: 150 ksi  
 Ult. Strength:  
 Specimen Thk: 0.251 - 0.252 in.  
 Specimen Width: 0.996 - 1 in.  
 Ref: GE007



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
10.48 (min)	3.27
13.	6.41
16.	12.1
19.06 (max)	16.6

ΔK (Ksi√in) da/dN (10<sup>-6</sup>in/cycle)

RMS %  
Error  
13.84

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 6.16.3.1.11 (Concluded)

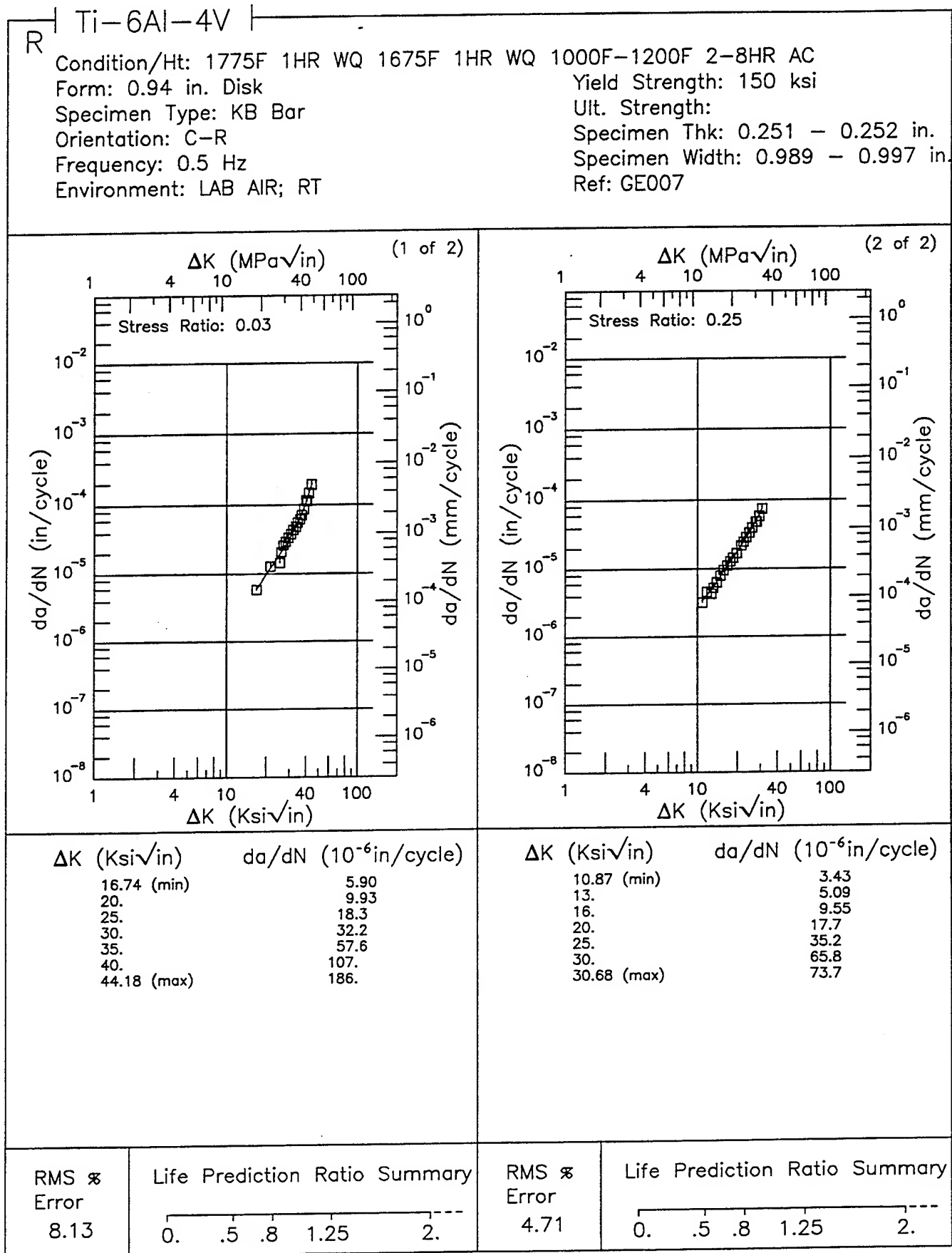


Figure 6.16.3.1.12

Condition/Ht: 1950F 4HRS WQ 1000F 4HRS ARGON COOLED  
 Form: Forging  
 Specimen Type: WOL  
 Orientation: R-C  
 Stress Ratio: 0.1  
 Frequency: 10 Hz

Yield Strength: 136.4 ksi  
 Ult. Strength: 147.8 ksi  
 Specimen Thk: 0.8 in.  
 Specimen Width: 2.55 in.  
 Ref: UM001

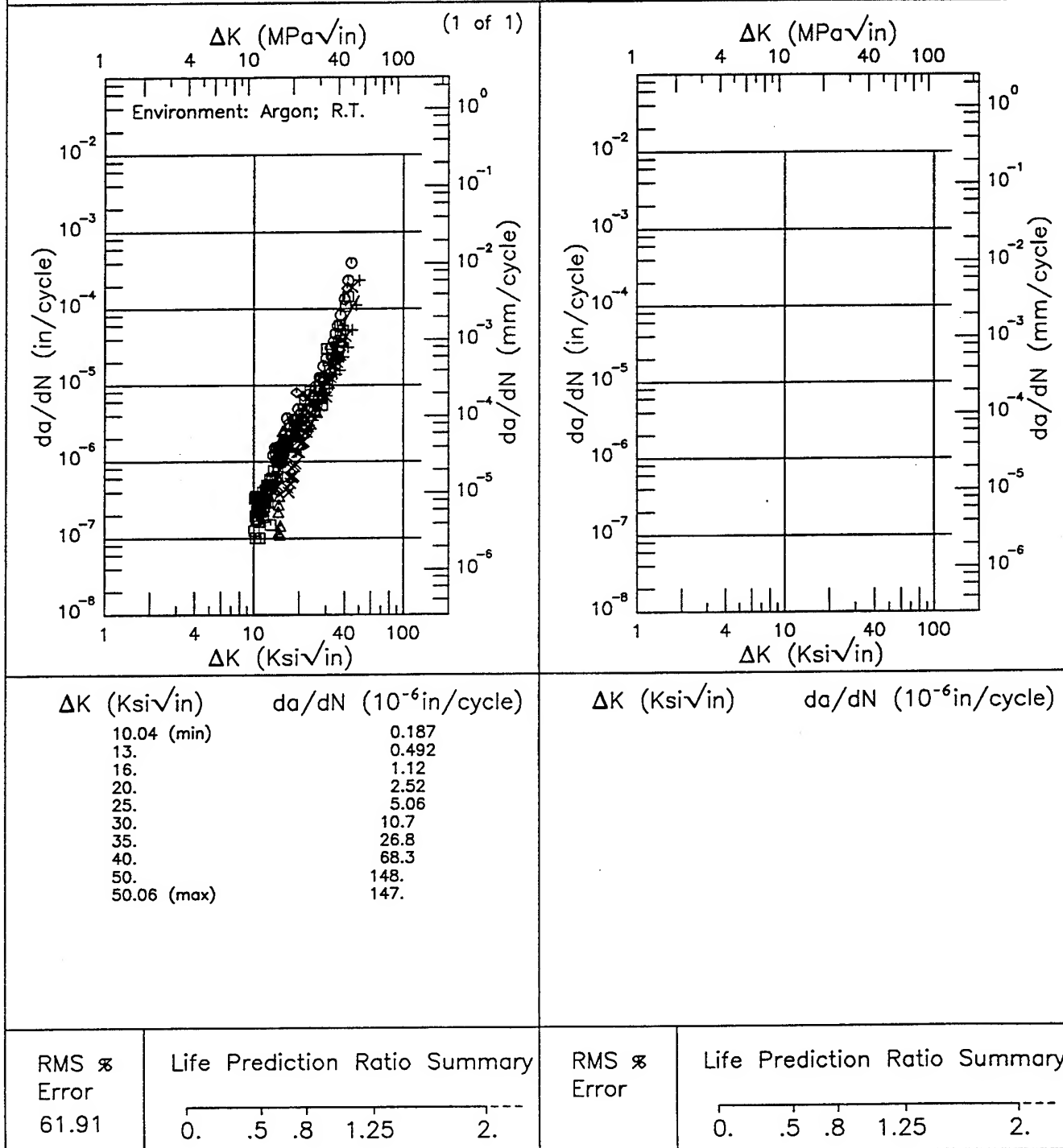


Figure 6.16.3.1.13



Ti-6Al-4V

E

Condition/Ht: 1950F 4HRS WQ 1000F 4HRS ARGON COOLED

Form: Forging

Specimen Type: WOL

Orientation: C-R

Stress Ratio: 0.1

Frequency: 10 Hz

Yield Strength: 136.4 ksi

Ult. Strength: 147.8 ksi

Specimen Thk: 0.8 in.

Specimen Width: 2.55 in.

Ref: UM001

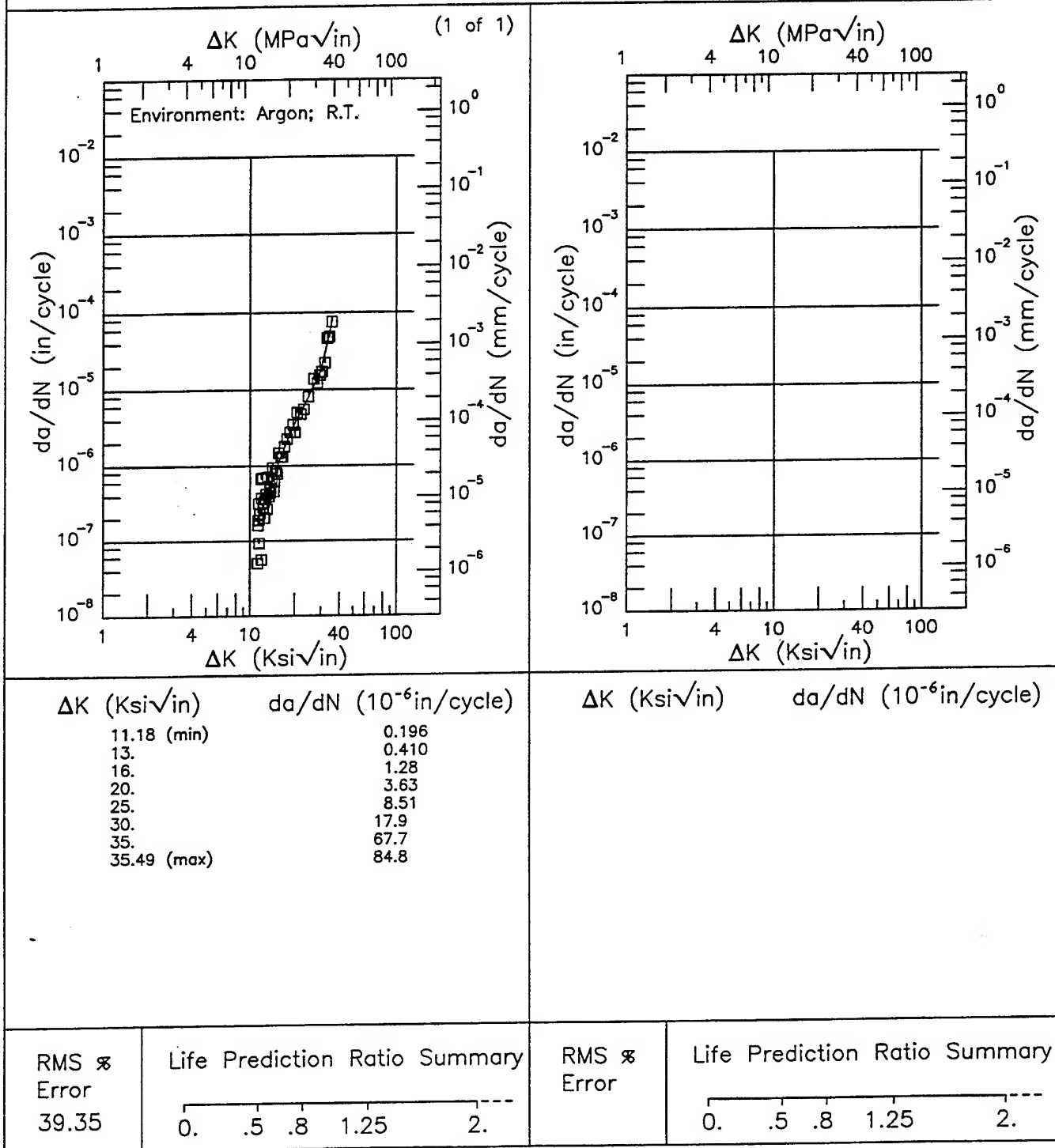


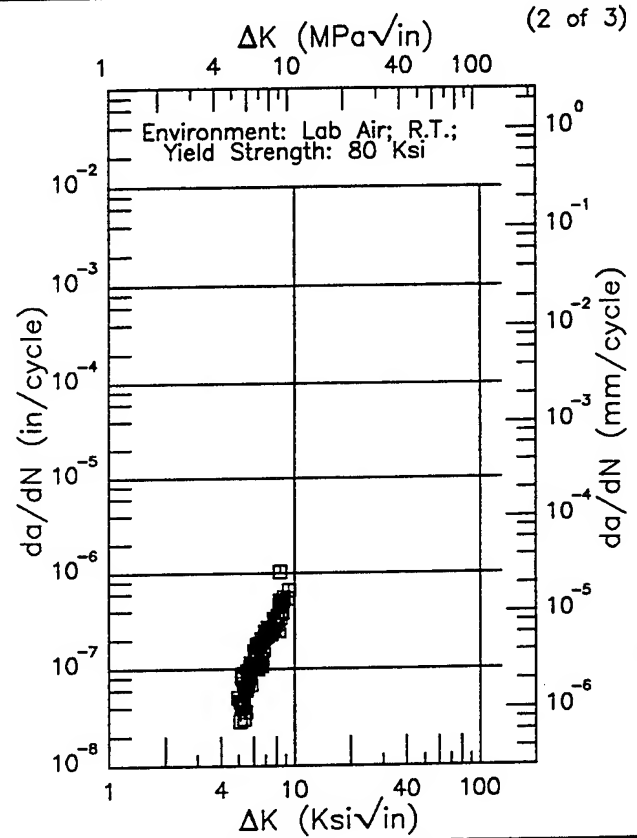
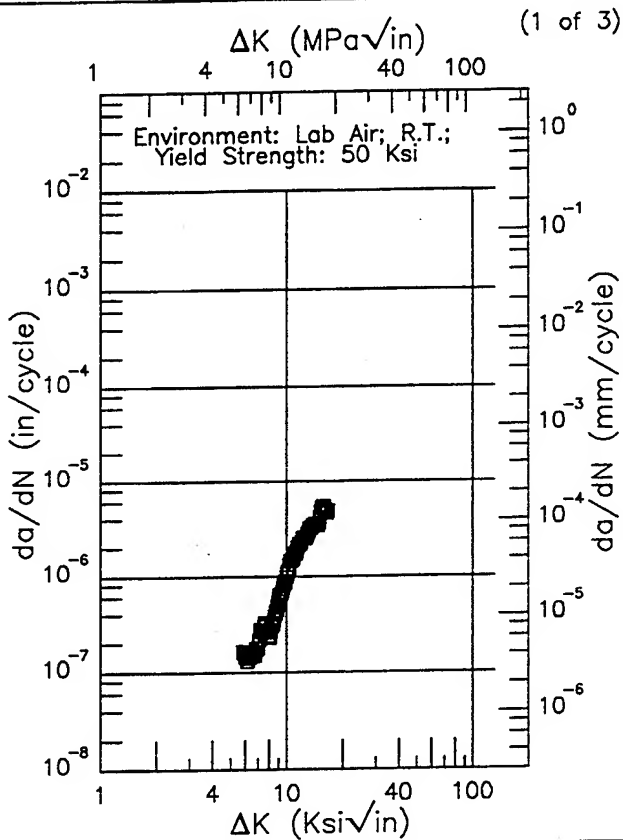
Figure 6.16.3.1.14

**This page intentionally left blank**

Ti-6Al-4V

Condition/Ht: ALPHA-BETA FORGE-ANNEALED  
 Form: Forging  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.1  
 Frequency: 30 Hz

Yield Strength: 50 - 100 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.252 in.  
 Specimen Width: 1.993 - 2.01 in.  
 Ref: SA001



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
5.82 (min)	0.131
6.	0.140
7.	0.193
8.	0.287
9.	0.523
10.	1.02
13.	2.81
16.	4.89
16.51 (max)	4.90

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
4.93 (min)	0.0436
5.	0.0451
6.	0.110
7.	0.203
8.	0.331
9.	0.560
9.27 (max)	0.562

RMS %  
Error  
12.44

Life Prediction Ratio Summary  

0.5 1.0 1.25 2.0

RMS %  
Error  
24.71

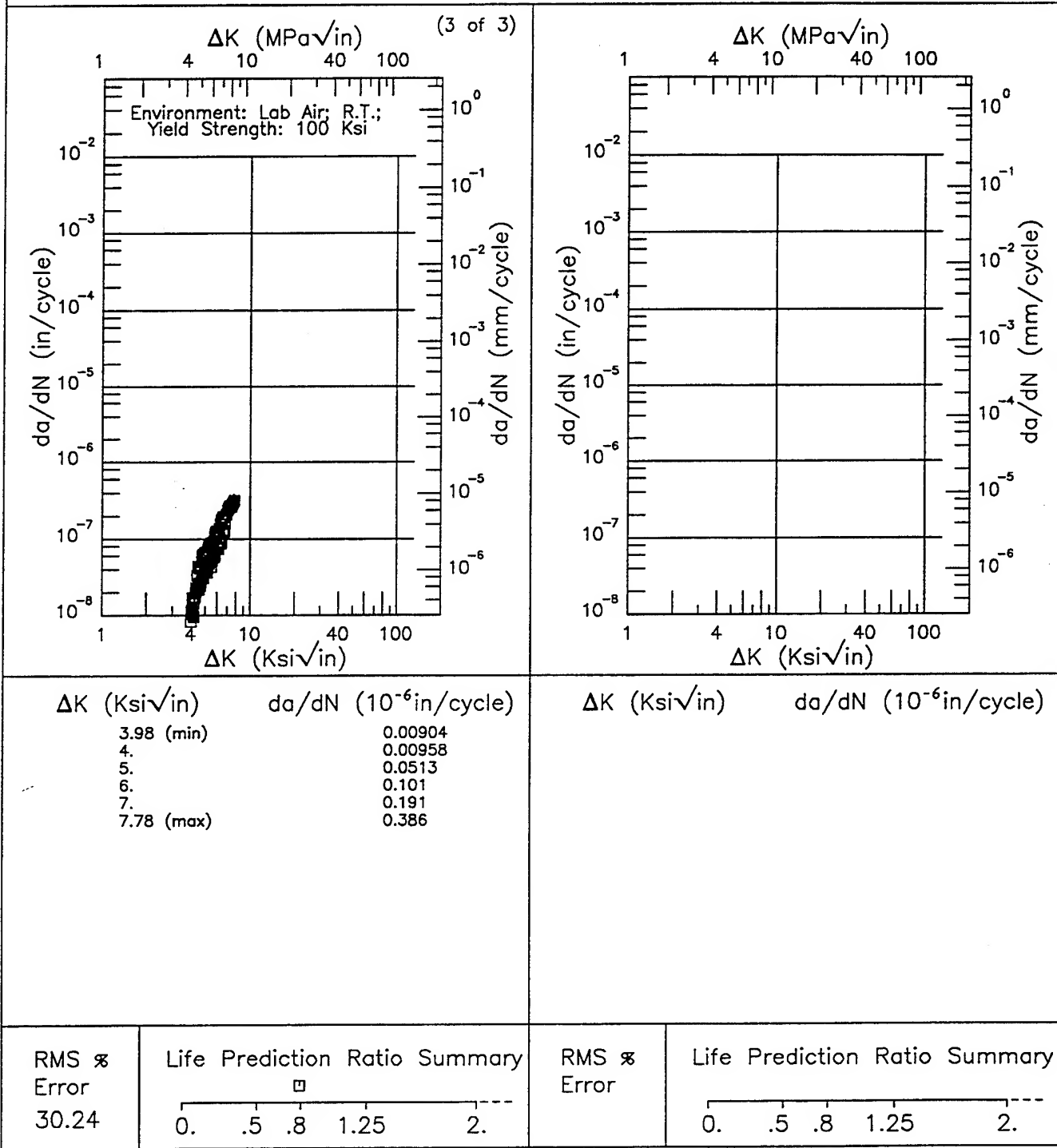
Life Prediction Ratio Summary  

0.5 1.0 1.25 2.0

Figure 6.16.3.1.15

Condition/Ht: ALPHA-BETA FORGE-ANNEALED  
 Form: Forging  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.1  
 Frequency: 30 Hz

Yield Strength: 50 - 100 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.252 in.  
 Specimen Width: 1.993 - 2.01 in.  
 Ref: SA001



$\Delta K$ (Ksi√in)	$da/dN$ (10 <sup>-6</sup> in/cycle)
---------------------	-------------------------------------

RMS % Error

30.24

Life Prediction Ratio Summary

0.5.81.252.

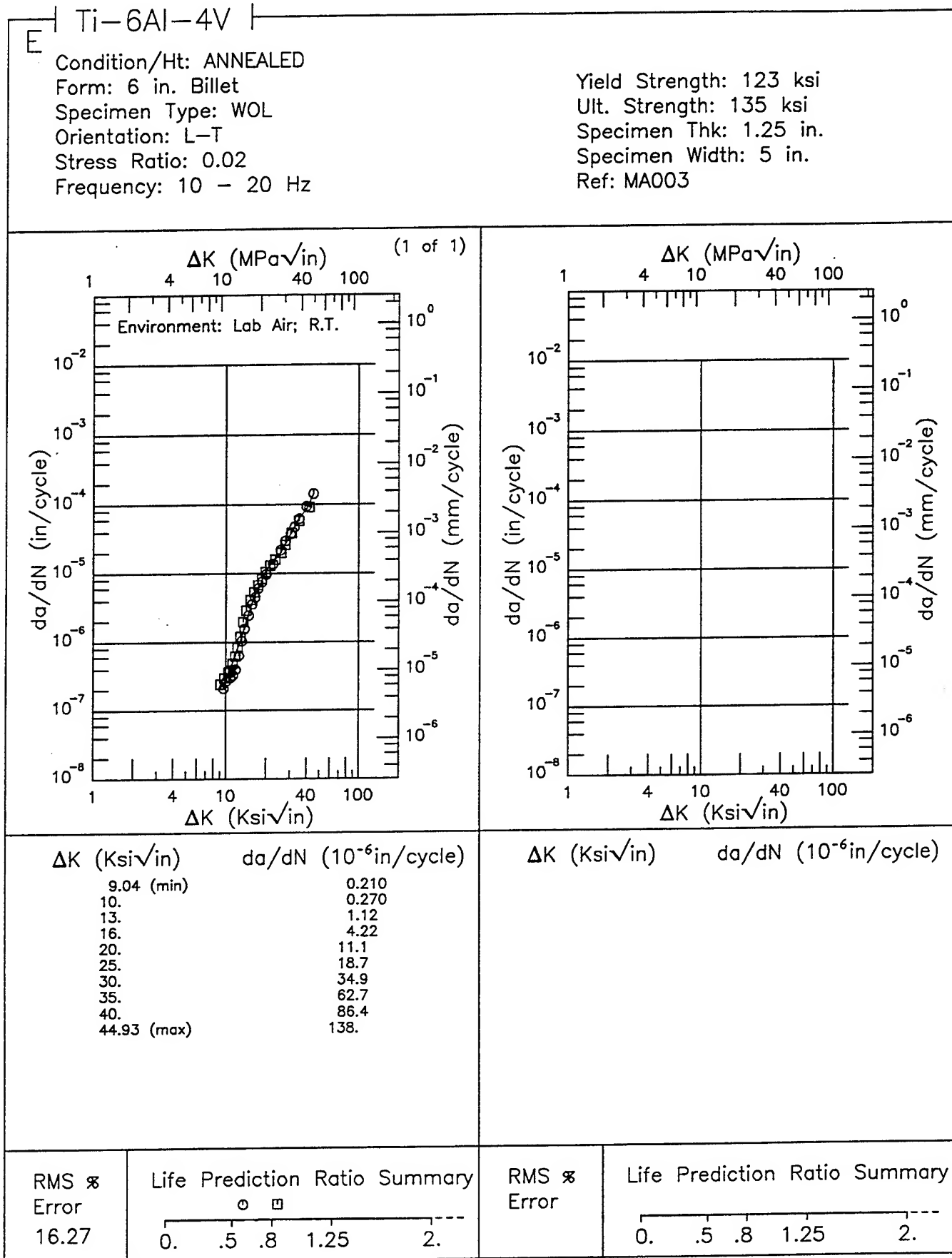
RMS % Error

Life Prediction Ratio Summary

0.5.81.252.

Figure 6.16.3.1.15 (Concluded)

6-251



RMS % Error: 16.27

Life Prediction Ratio Summary

○ □

0. .5 .8 1.25 2.

RMS % Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

**Figure 6.16.3.1.16**

Condition/Ht: ANNEALED  
 Form: 1.75 in. Extrusion  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 1 Hz  
 Environment: DIST WATER; RT

Yield Strength: 127.2 - 131.6 ksi  
 Ult. Strength:  
 Specimen Thk: 0.247 - 0.252 in.  
 Specimen Width: 2 - 2.008 in.  
 Ref: DA006;DA007

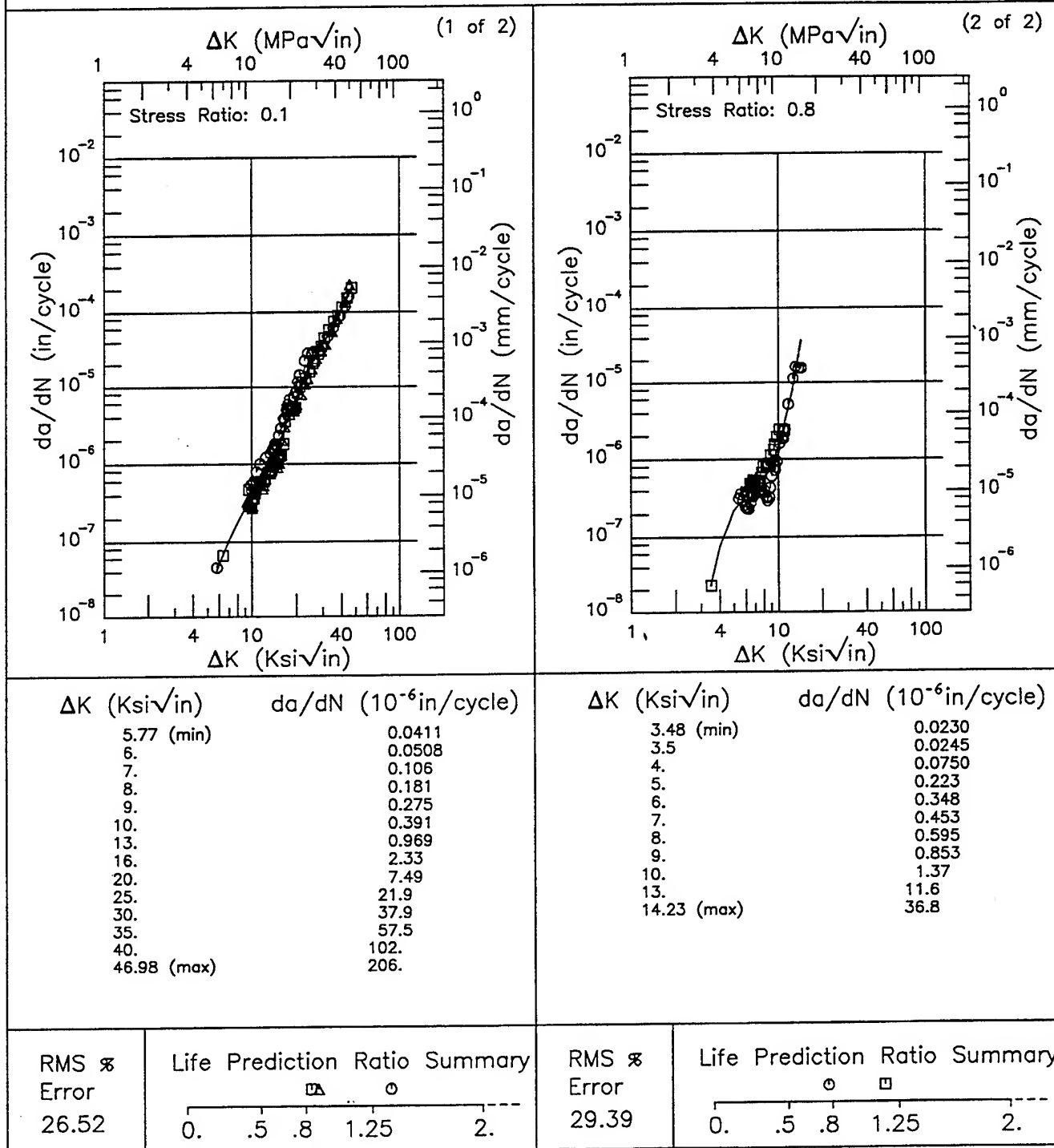


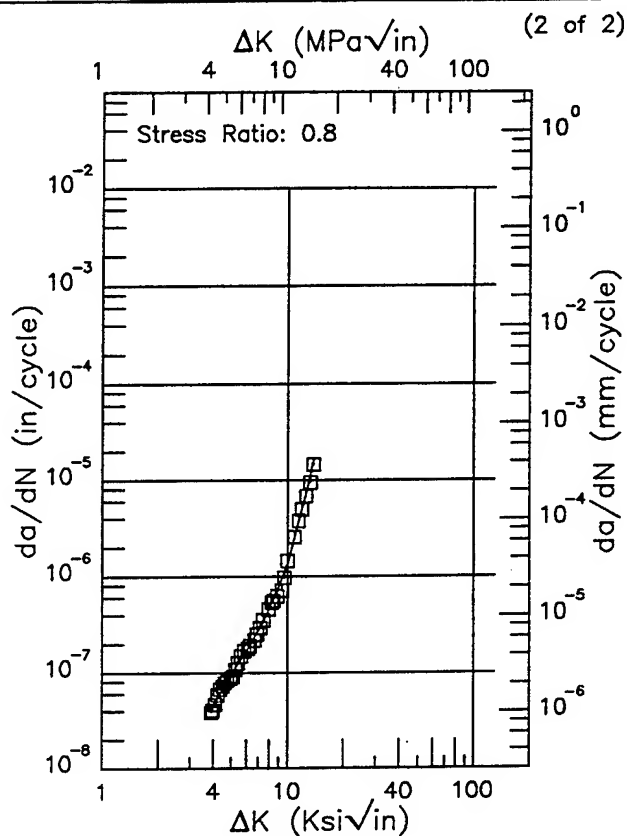
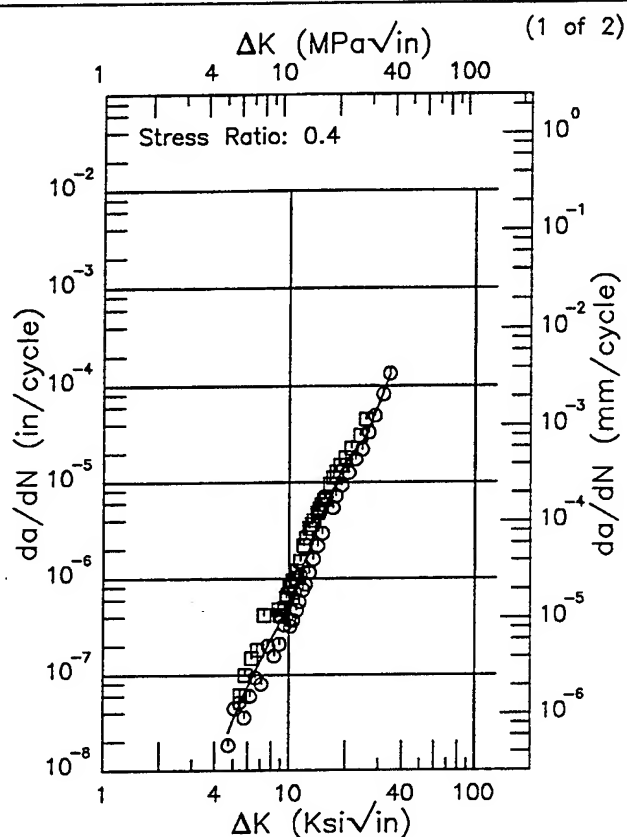
Figure 6.16.3.1.17

R

Ti-6Al-4V

Condition/Ht: ANNEALED  
 Form: 1.75 in. Extrusion  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 15 Hz  
 Environment: LAB AIR; RT

Yield Strength: 127.2 - 131.6 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.251 in.  
 Specimen Width: 2.001 - 2.003 in.  
 Ref: DA006;DA007

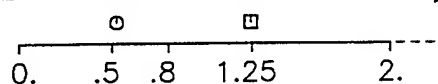


$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
4.70 (min)	0.0249
5.	0.0340
6.	0.0770
7.	0.142
8.	0.235
9.	0.371
10.	0.572
13.	2.07
16.	6.55
20.	16.5
25.	28.2
30.	64.3
34.29 (max)	128.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
3.88 (min)	0.0402
4.	0.0453
5.	0.0961
6.	0.167
7.	0.276
8.	0.458
9.	0.779
10.	1.37
13.	9.09
13.76 (max)	15.3

RMS  $\%$   
 Error  
 38.93

Life Prediction Ratio Summary



RMS  $\%$   
 Error  
 7.41

Life Prediction Ratio Summary

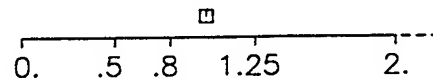
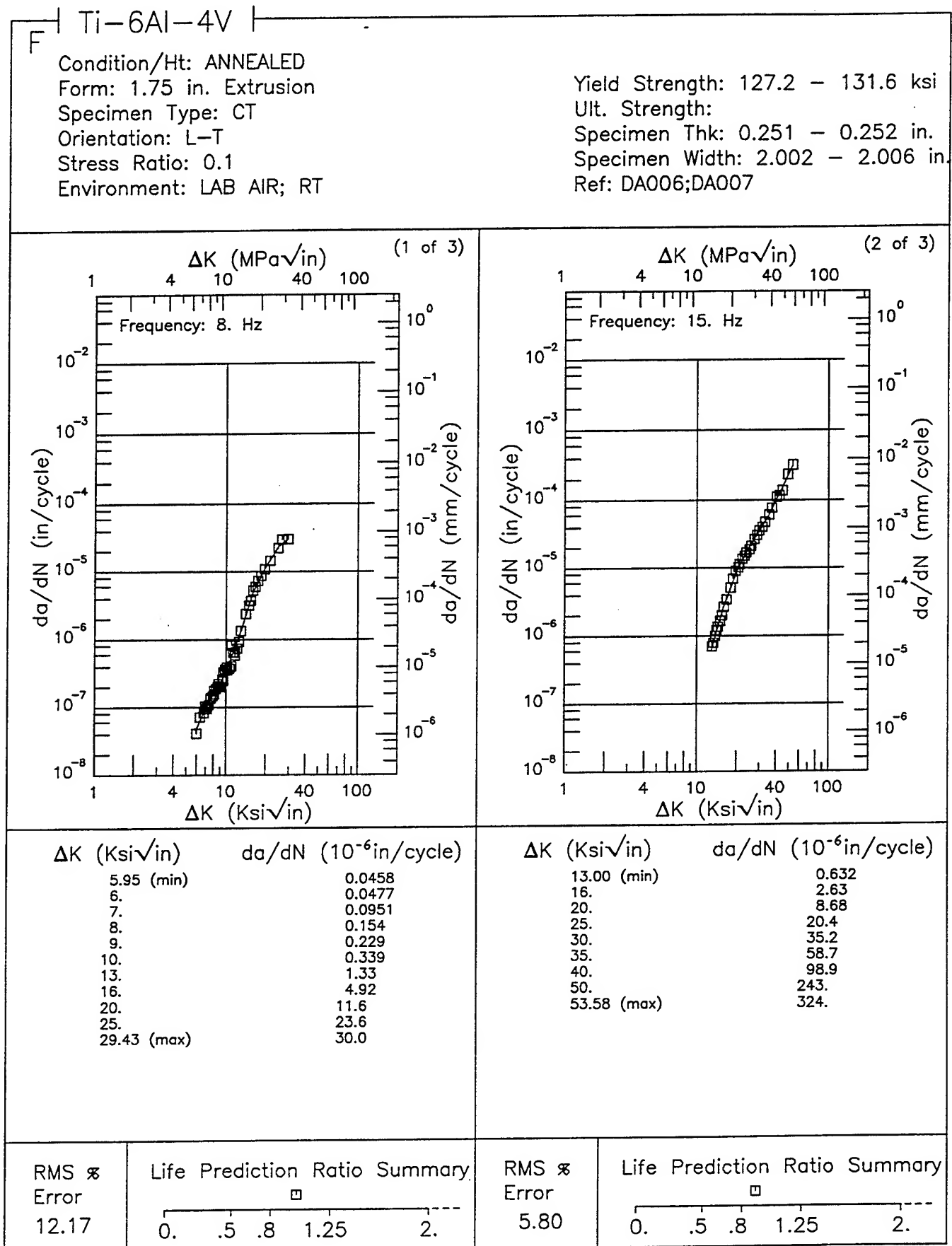


Figure 6.16.3.1.18

**This page intentionally left blank**





**Figure 6.16.3.1.19**

Condition/Ht: ANNEALED  
Form: 1.75 in. Extrusion  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.1  
Environment: LAB AIR; RT

Yield Strength: 127.2 - 131.6 ksi  
Ult. Strength:  
Specimen Thk: 0.251 - 0.252 in.  
Specimen Width: 2.002 - 2.006 in.  
Ref: DA006;DA007

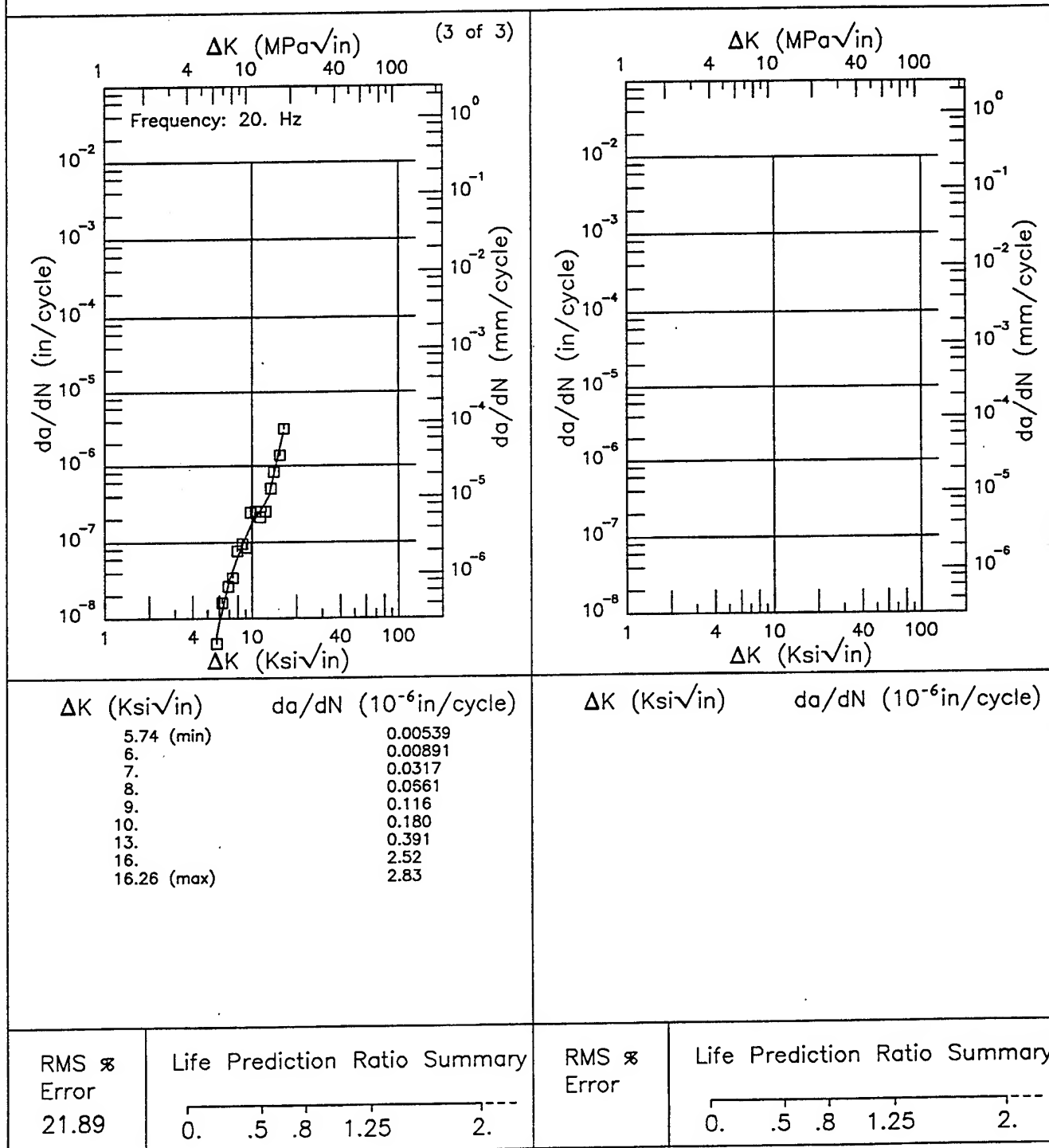


Figure 6.16.3.1.19 (Concluded)

F

Ti-6Al-4V

Condition/Ht: ANNEALED  
 Form: 1.75 in. Extrusion  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.8  
 Environment: LAB AIR; RT

Yield Strength: 127.2 - 131.6 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.253 in.  
 Specimen Width: 2 - 2.004 in.  
 Ref: DA006;DA007

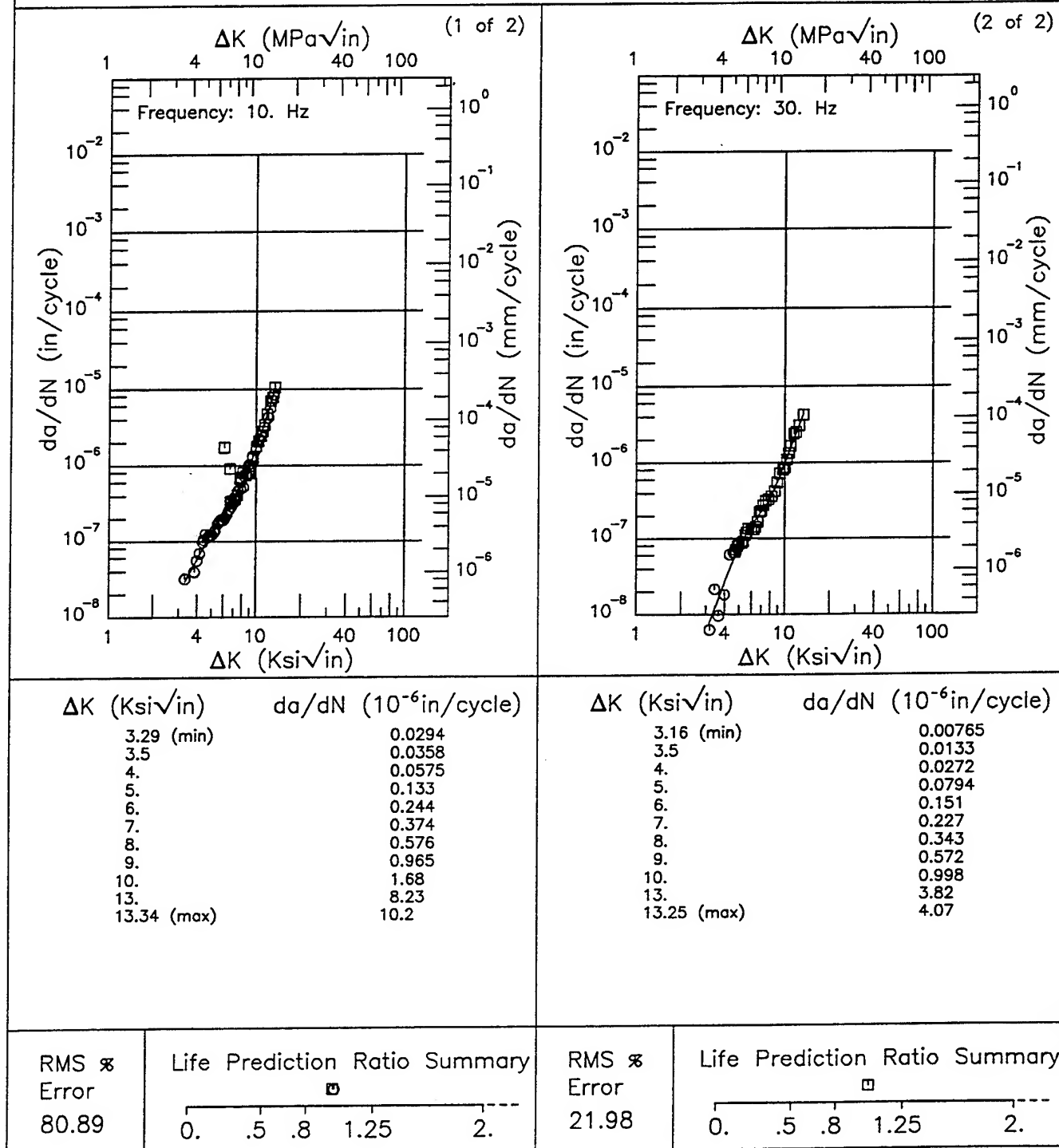


Figure 6.16.3.1.20

Ti-6Al-4V R

Condition/Ht: ANNEALED  
 Form: 1.75 in. Extrusion  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 5 - 15 Hz  
 Environment: LAB AIR; RT

Yield Strength: 131.4 ksi  
 Ult. Strength:  
 Specimen Thk: 0.249 - 0.25 in.  
 Specimen Width: 2.002 - 2.006 in.  
 Ref: DA006

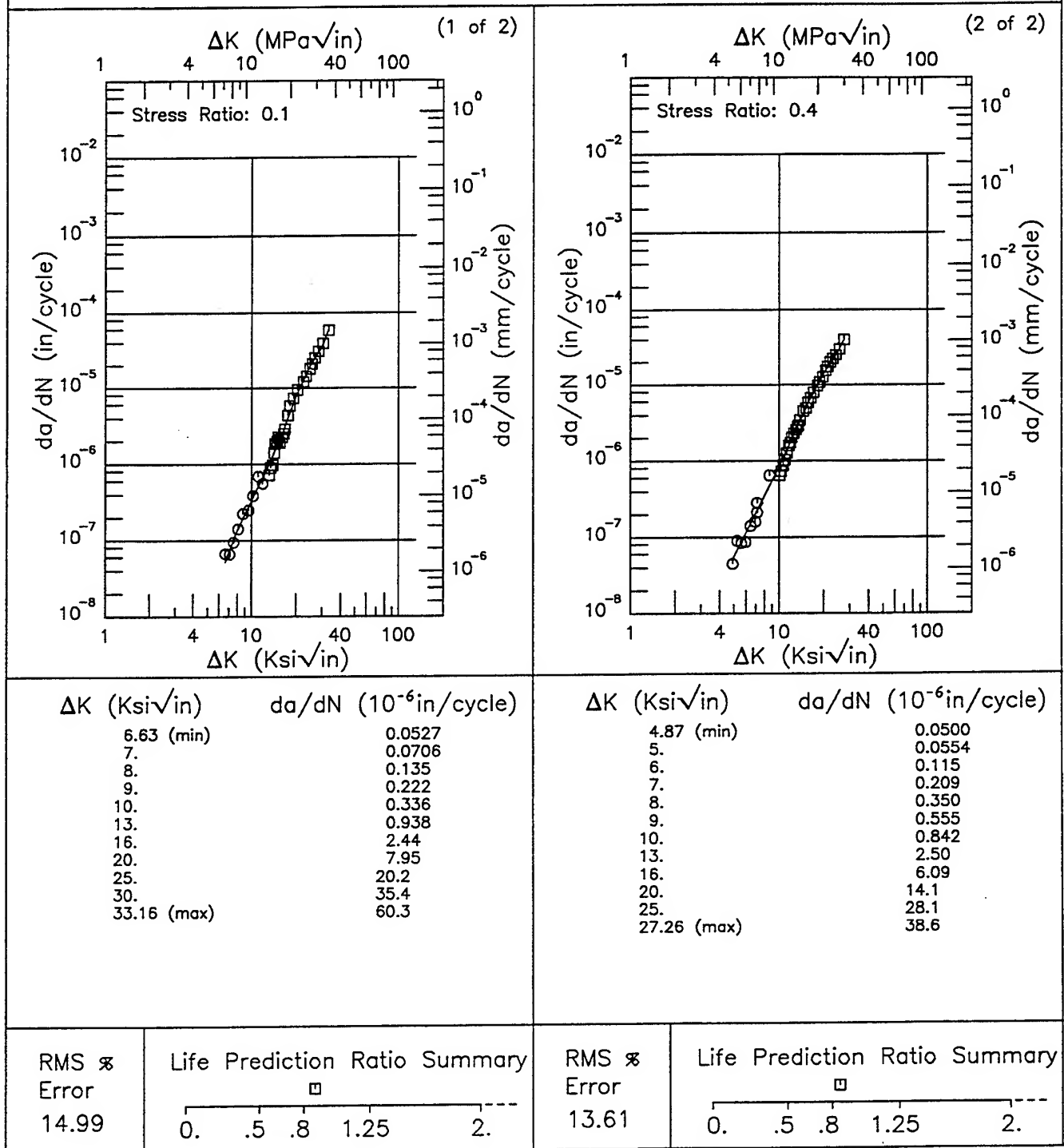


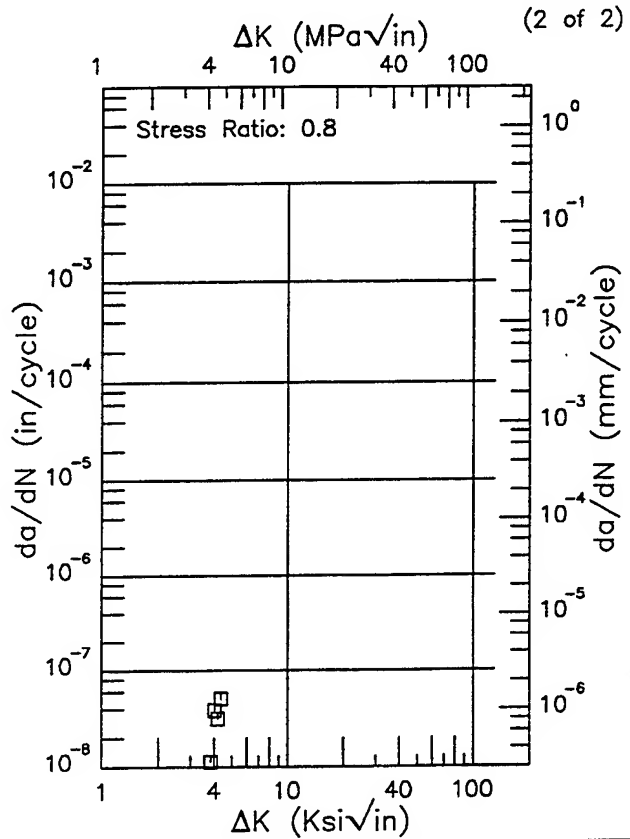
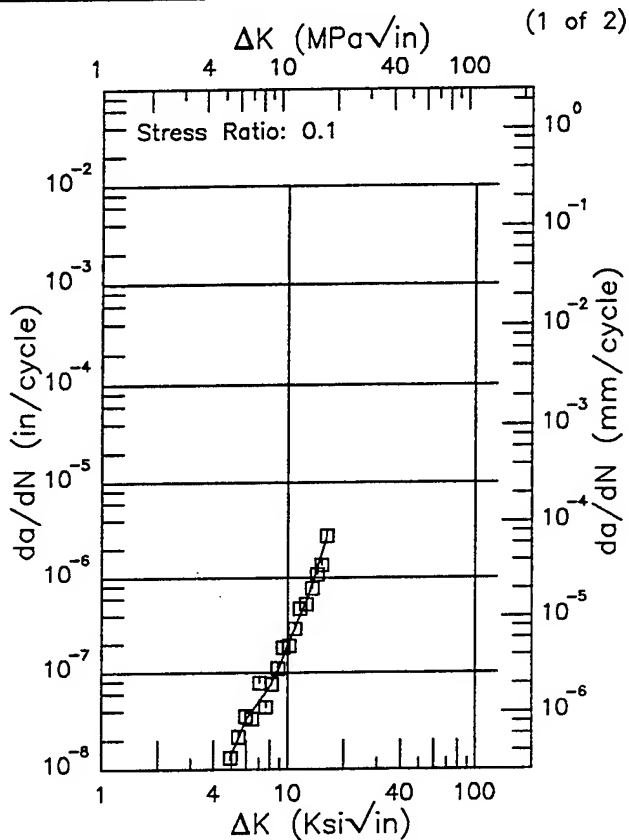
Figure 6.16.3.1.21

R

Ti-6Al-4V

Condition/Ht: ANNEALED  
 Form: 1.75 in. Extrusion  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 20 Hz  
 Environment: LAB AIR; RT

Yield Strength: 127.9 ksi  
 Ult. Strength:  
 Specimen Thk: 0.251 in.  
 Specimen Width: 1.998 - 2 in.  
 Ref: DA007



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
4.89 (min)	0.0126
5.	0.0145
6.	0.0331
7.	0.0502
8.	0.0724
9.	0.115
10.	0.197
13.	0.675
16.	2.60
16.01 (max)	2.62

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
---------------------	-------------------------------

RMS %  
 Error  
 18.88

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
 Error

Life Prediction Ratio Summary

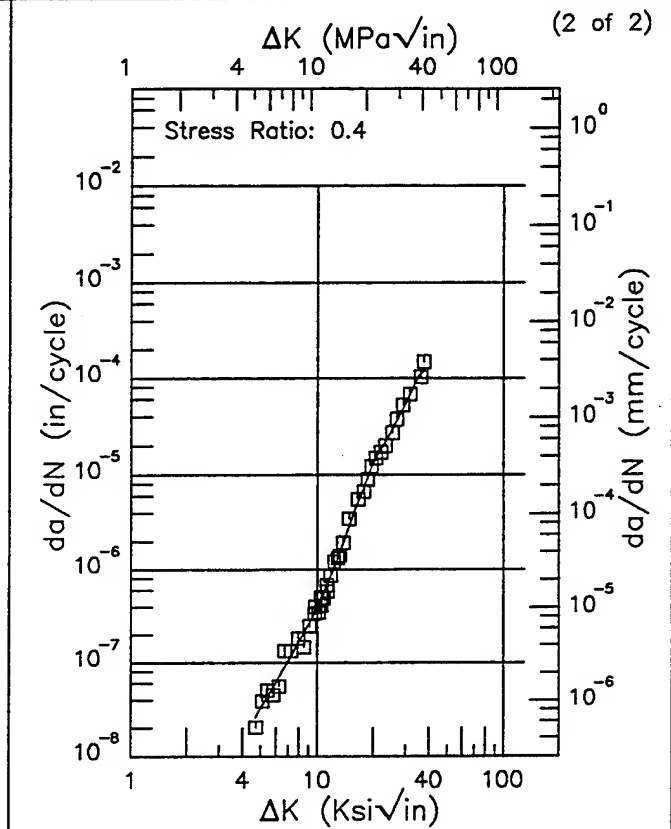
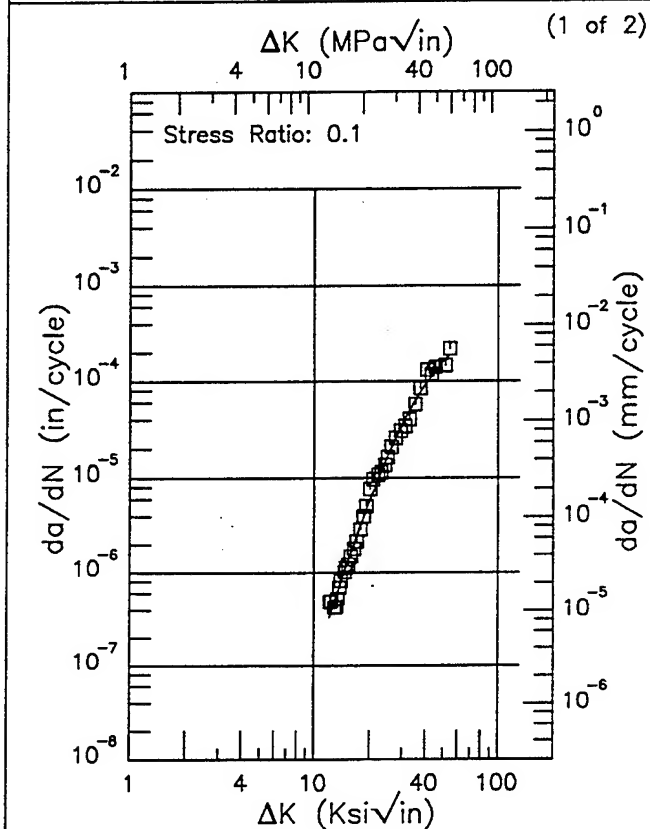
0. .5 .8 1.25 2.---

Figure 6.16.3.1.22

Ti-6Al-4V R

Condition/Ht: ANNEALED  
Form: 1.75 in. Extrusion  
Specimen Type: CT  
Orientation: T-L  
Frequency: 15 Hz  
Environment: LAB AIR; RT

Yield Strength: 127.9 ksi  
Ult. Strength:  
Specimen Thk: 0.25 - 0.251 in.  
Specimen Width: 2.002 - 2.003 in.  
Ref: DA007



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.19 (min)	0.330
13.	0.498
16.	1.74
20.	5.84
25.	16.9
30.	35.7
35.	61.9
40.	93.4
50.	162.
54.07 (max)	188.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
4.69 (min)	0.0257
5.	0.0323
6.	0.0613
7.	0.104
8.	0.167
9.	0.260
10.	0.398
13.	1.37
16.	4.34
20.	13.4
25.	28.1
30.	54.2
35.	105.
37.43 (max)	119.

RMS %  
Error  
16.54

Life Prediction Ratio Summary  
0. .5 .8 1.25 2.

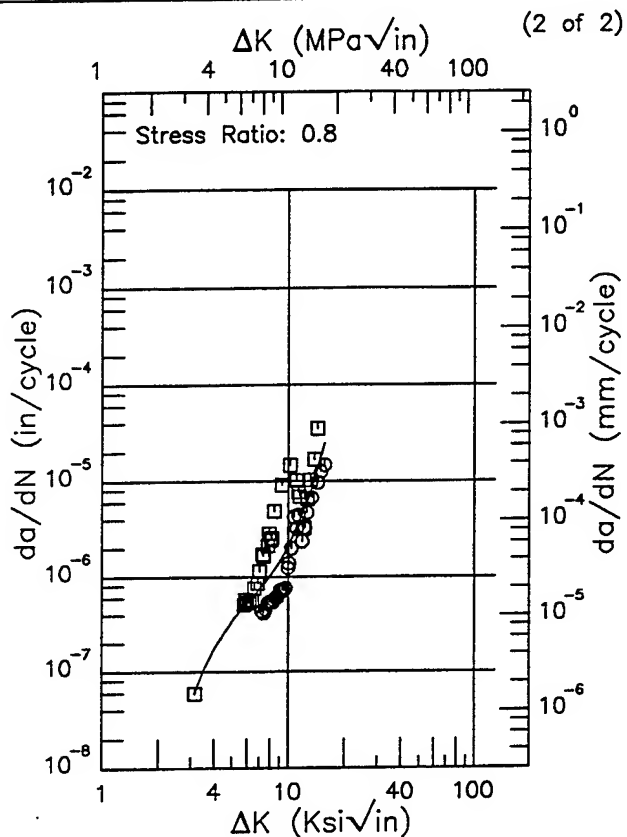
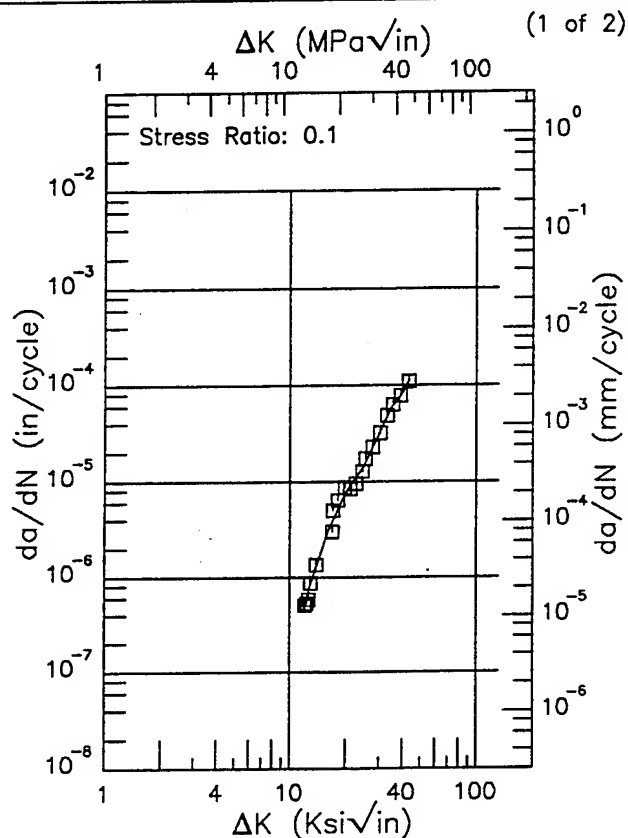
RMS %  
Error  
15.11

Life Prediction Ratio Summary  
0. .5 .8 1.25 2.

Figure 6.16.3.1.23

R | Ti-6Al-4V |  
 Condition/Ht: ANNEALED  
 Form: 1.75 in. Extrusion  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 1 Hz  
 Environment: DIST WATER; RT

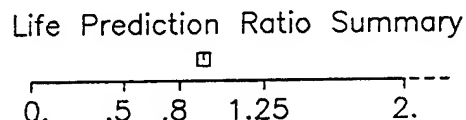
Yield Strength: 127.9 - 131.4 ksi  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.251 in.  
 Specimen Width: 1.998 - 2.02 in.  
 Ref: DA007;DA006



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
11.99 (min)	0.469
13.	0.863
16.	3.06
20.	7.72
25.	14.9
30.	31.2
35.	60.1
40.	83.0
43.11 (max)	109.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
3.13 (min)	0.0591
3.5	0.102
4.	0.175
5.	0.341
6.	0.523
7.	0.737
8.	1.02
9.	1.43
10.	2.04
13.	7.00
15.64 (max)	24.8

RMS %  
 Error  
 12.44



RMS %  
 Error  
 >100.0

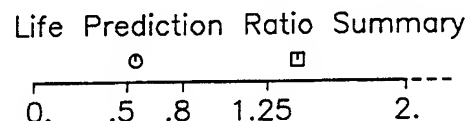


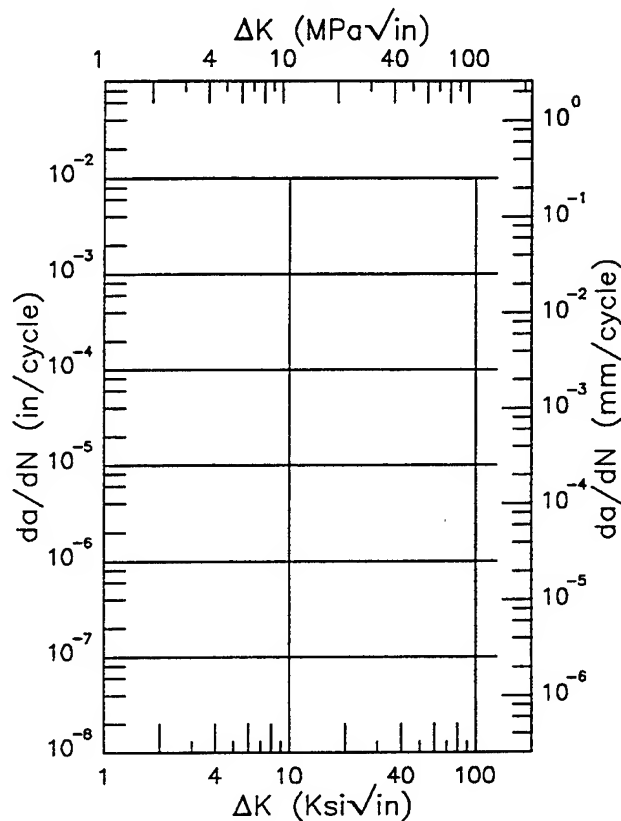
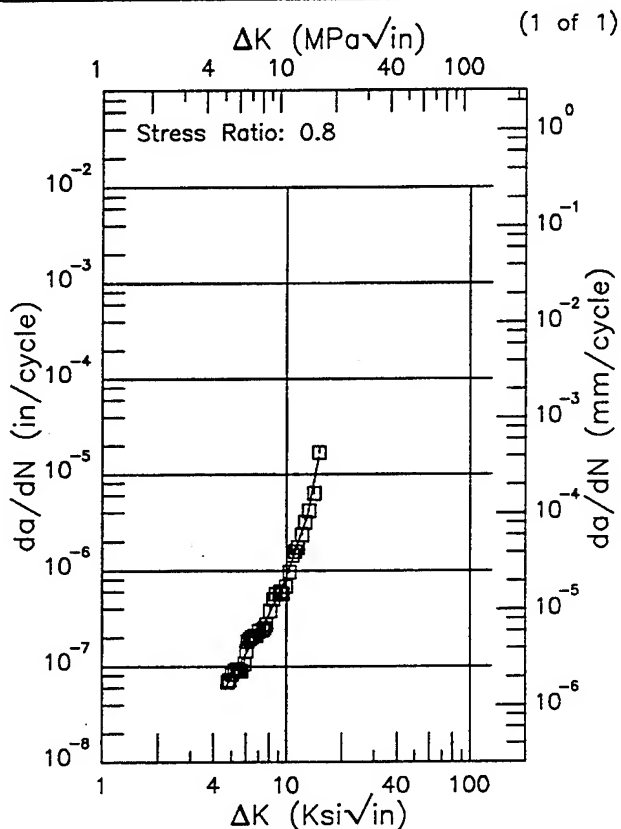
Figure 6.16.3.1.24

Ti-6Al-4V

R

Condition/Ht: ANNEALED  
 Form: 1.75 in. Extrusion  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 30 Hz  
 Environment: LAB AIR; RT

Yield Strength: 127.9 ksi  
 Ult. Strength:  
 Specimen Thk: 0.251 in.  
 Specimen Width: 2 in.  
 Ref: DA007



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
4.75 (min)	0.0646
5.	0.0765
6.	0.135
7.	0.221
8.	0.350
9.	0.552
10.	0.872
13.	3.62
14.97 (max)	15.2

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS %  
 Error  
 12.09

Life Prediction Ratio Summary

0.    .5    .8    1.25    2. ---

RMS %  
 Error

Life Prediction Ratio Summary

0.    .5    .8    1.25    2. ---

Figure 6.16.3.1.25

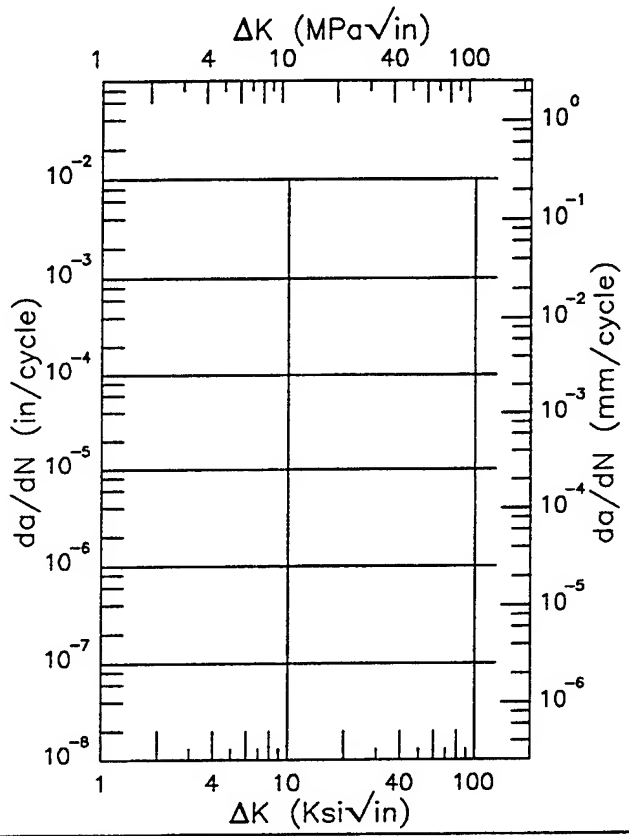
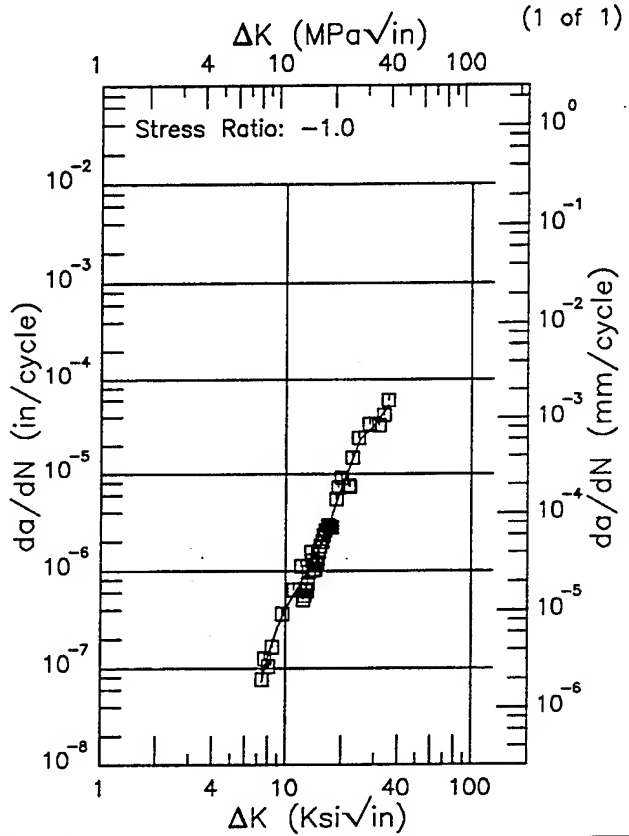


R

Ti-6Al-4V

Condition/Ht: ANNEALED  
 Form: 1.75 in. Extrusion  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Frequency: 5 Hz  
 Environment: LAB AIR; RT

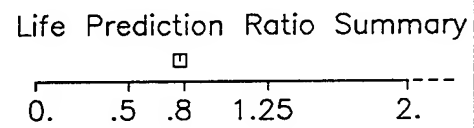
Yield Strength: 131.6 ksi  
 Ult. Strength:  
 Specimen Thk: 0.198 in.  
 Specimen Width: 4.009 in.  
 Ref: DA006



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
7.42 (min)	0.0720
8.	0.129
9.	0.260
10.	0.414
13.	0.957
16.	2.04
20.	7.29
25.	23.4
30.	32.8
35.	51.0
35.32 (max)	53.6

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
--------------------------------------	-------------------------------

RMS %  
 Error  
 21.79



RMS %  
 Error

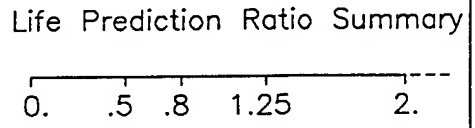


Figure 6.16.3.1.26

Ti-6Al-4V R

Condition/Ht: ANNEALED  
 Form: 3 in. Forging  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 1 Hz  
 Environment: DIST WATER; RT

Yield Strength: 131.7 ksi  
 Ult. Strength:  
 Specimen Thk: 0.245 - 0.246 in.  
 Specimen Width: 2.007 - 2.009 in.  
 Ref: DA006

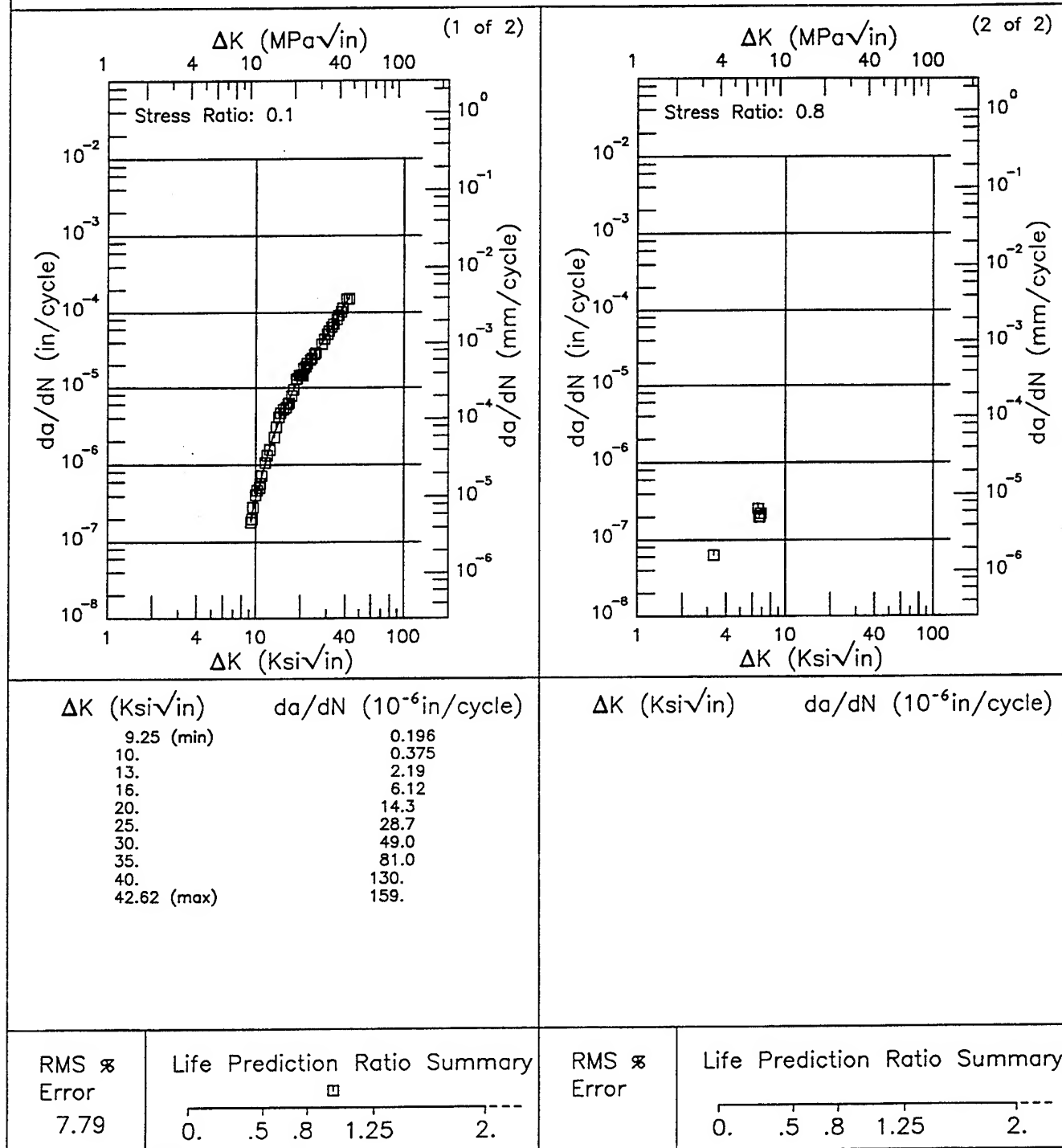


Figure 6.16.3.1.27

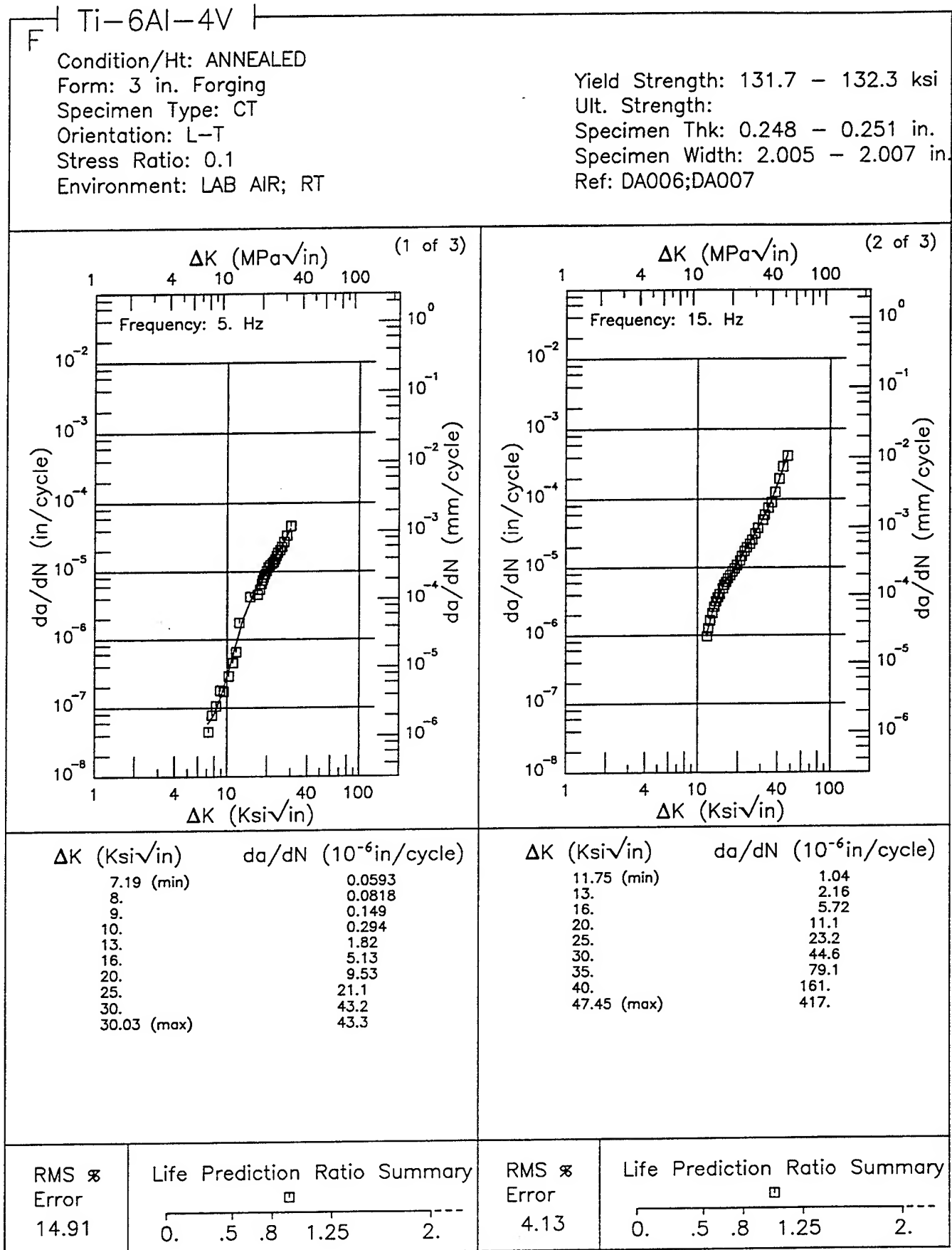


Figure 6.16.3.1.28

Ti-6Al-4V

F

Condition/Ht: ANNEALED  
Form: 3 in. Forging  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.1  
Environment: LAB AIR; RT

Yield Strength: 131.7 - 132.3 ksi  
Ult. Strength:  
Specimen Thk: 0.248 - 0.251 in.  
Specimen Width: 2.005 - 2.007 in.  
Ref: DA006;DA007

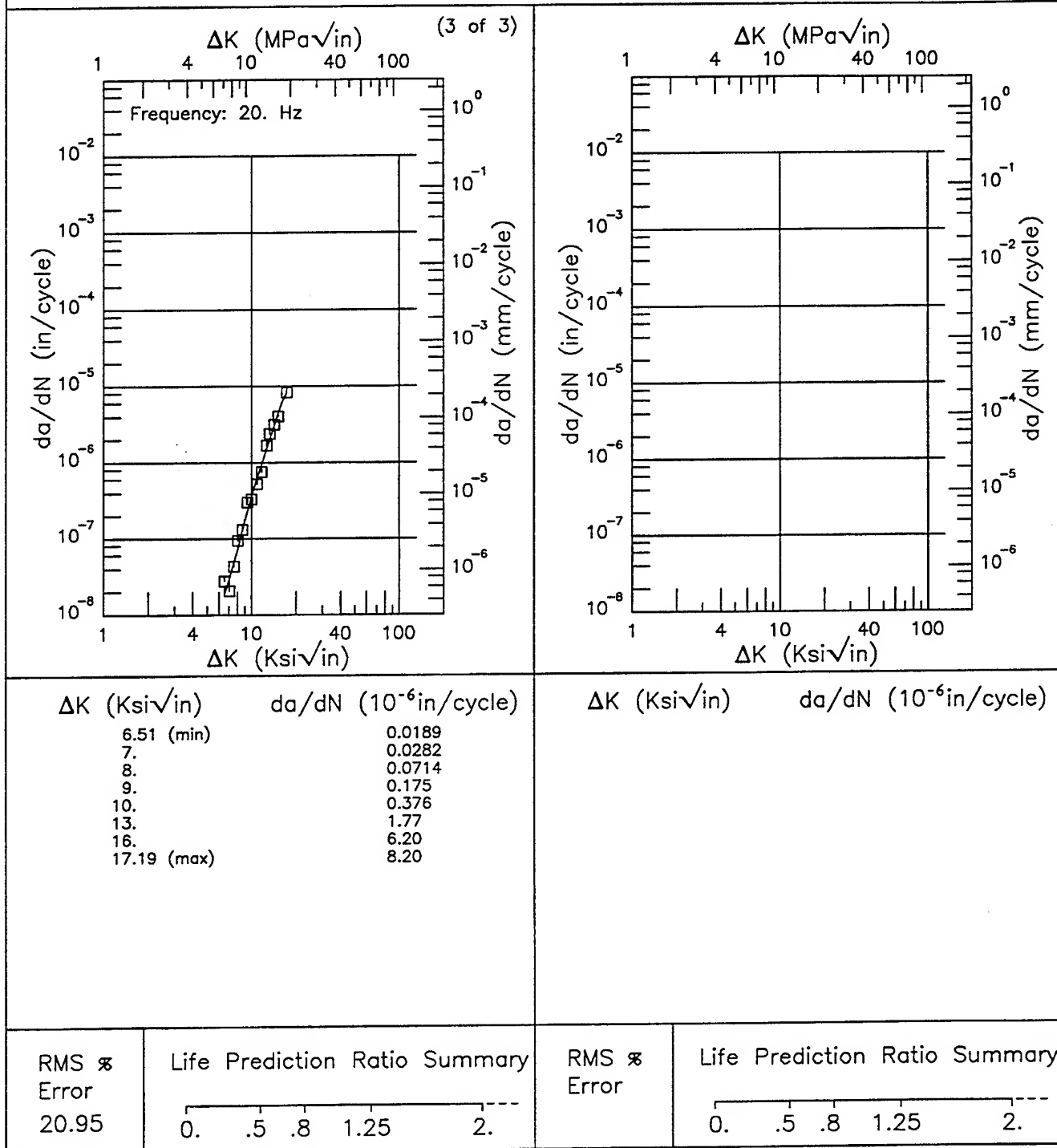
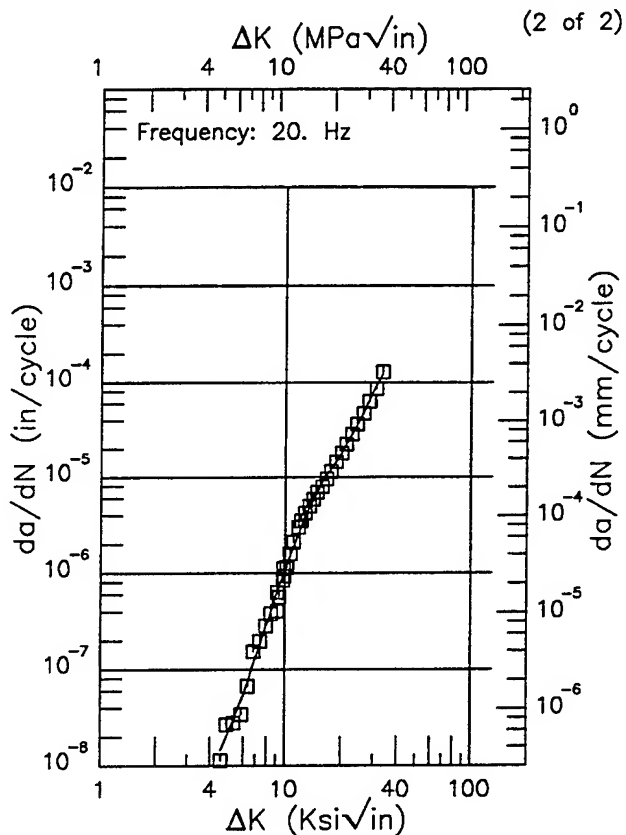
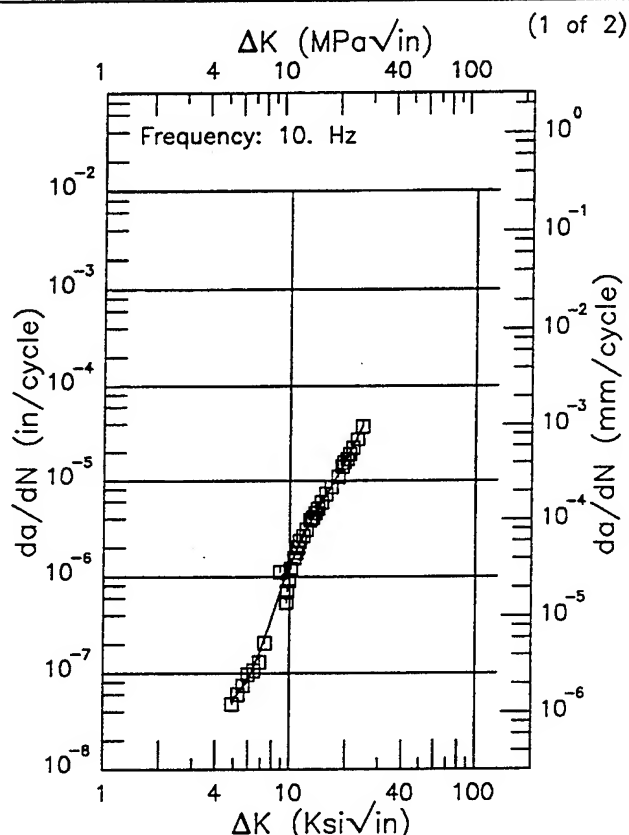


Figure 6.16.3.1.28 (Concluded)

F | Ti-6Al-4V |

Condition/Ht: ANNEALED  
 Form: 3 in. Forging  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.4  
 Environment: LAB AIR; RT

Yield Strength: 131.7 - 132.3 ksi  
 Ult. Strength:  
 Specimen Thk: 0.249 in.  
 Specimen Width: 2.005 - 2.008 in.  
 Ref: DA006;DA007



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
4.90 (min)	0.0531
5.	0.0537
6.	0.0847
7.	0.177
8.	0.381
9.	0.755
10.	1.32
13.	3.82
16.	7.65
20.	16.3
24.31 (max)	37.2

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
4.56 (min)	0.0144
5.	0.0215
6.	0.0546
7.	0.132
8.	0.293
9.	0.591
10.	1.09
13.	4.16
16.	9.07
20.	17.6
25.	38.4
30.	83.1
33.23 (max)	121.

RMS %  
 Error  
 17.37

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

RMS %  
 Error  
 14.81

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

Figure 6.16.3.1.29

Ti-6Al-4V F

Condition/Ht: ANNEALED  
 Form: 3 in. Forging  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.8  
 Environment: LAB AIR; RT

Yield Strength: 131.7 - 132.3 ksi  
 Ult. Strength:  
 Specimen Thk: 0.248 - 0.249 in.  
 Specimen Width: 2.005 - 2.006 in.  
 Ref: DA006;DA007

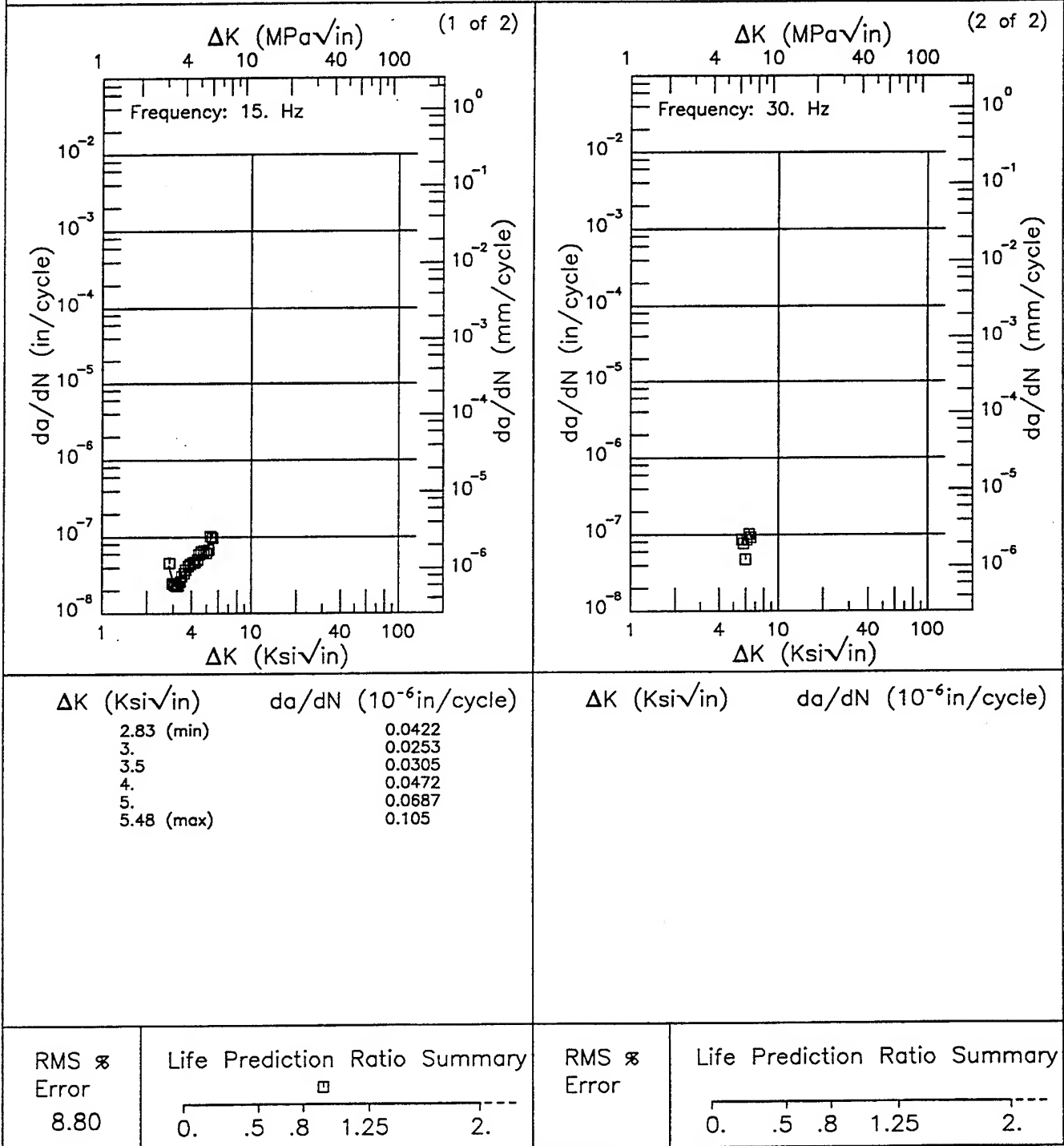


Figure 6.16.3.1.30

R

Ti-6Al-4V

Condition/Ht: ANNEALED

Form: 3 in. Forging

Specimen Type: CT

Orientation: T-L

Frequency: 1 Hz

Environment: DIST WATER; RT

Yield Strength: 140.1 - 144.9 ksi

Ult. Strength:

Specimen Thk: 0.248 - 0.25 in.

Specimen Width: 2 - 2.006 in.

Ref: DA006;DA007

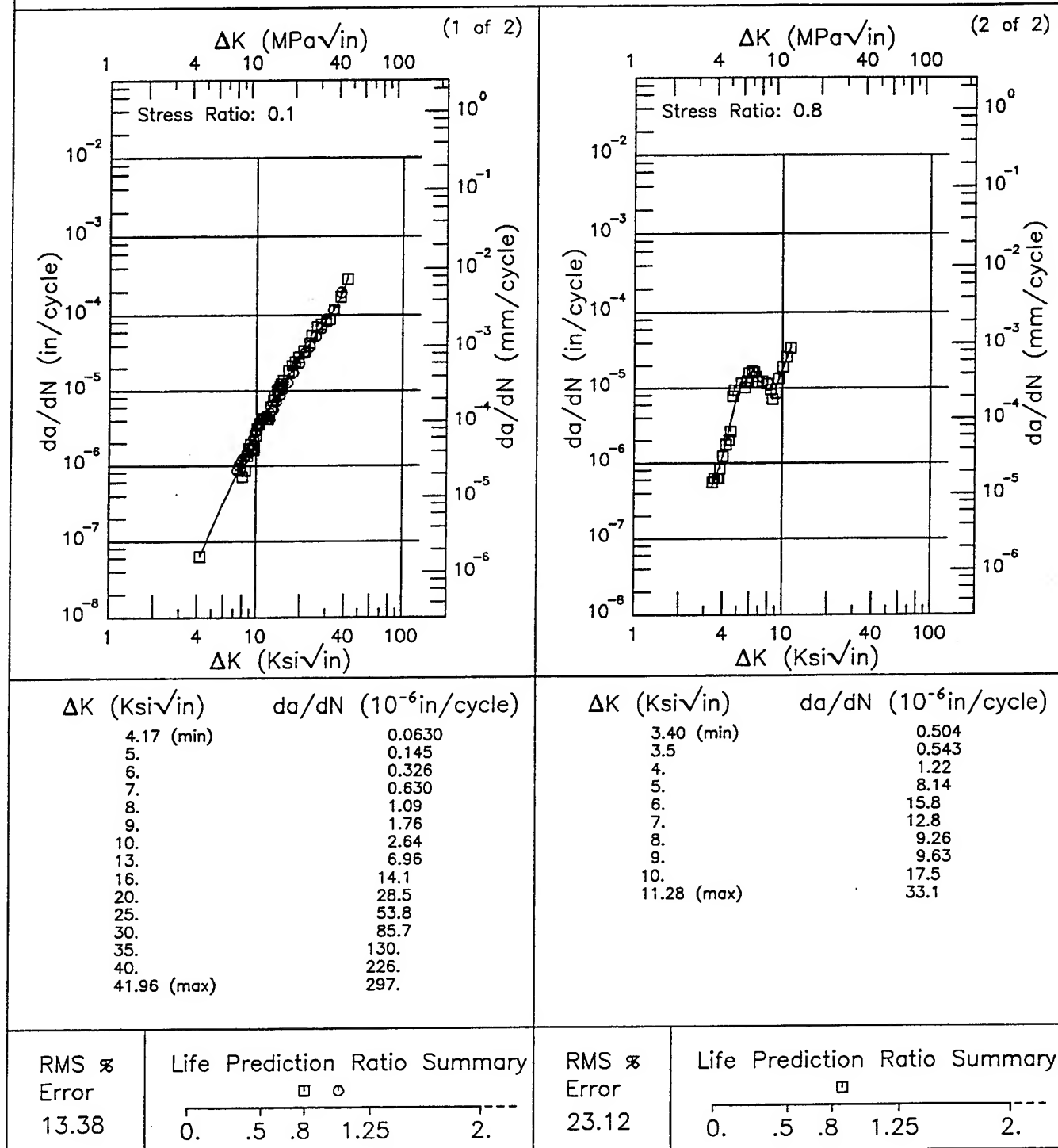
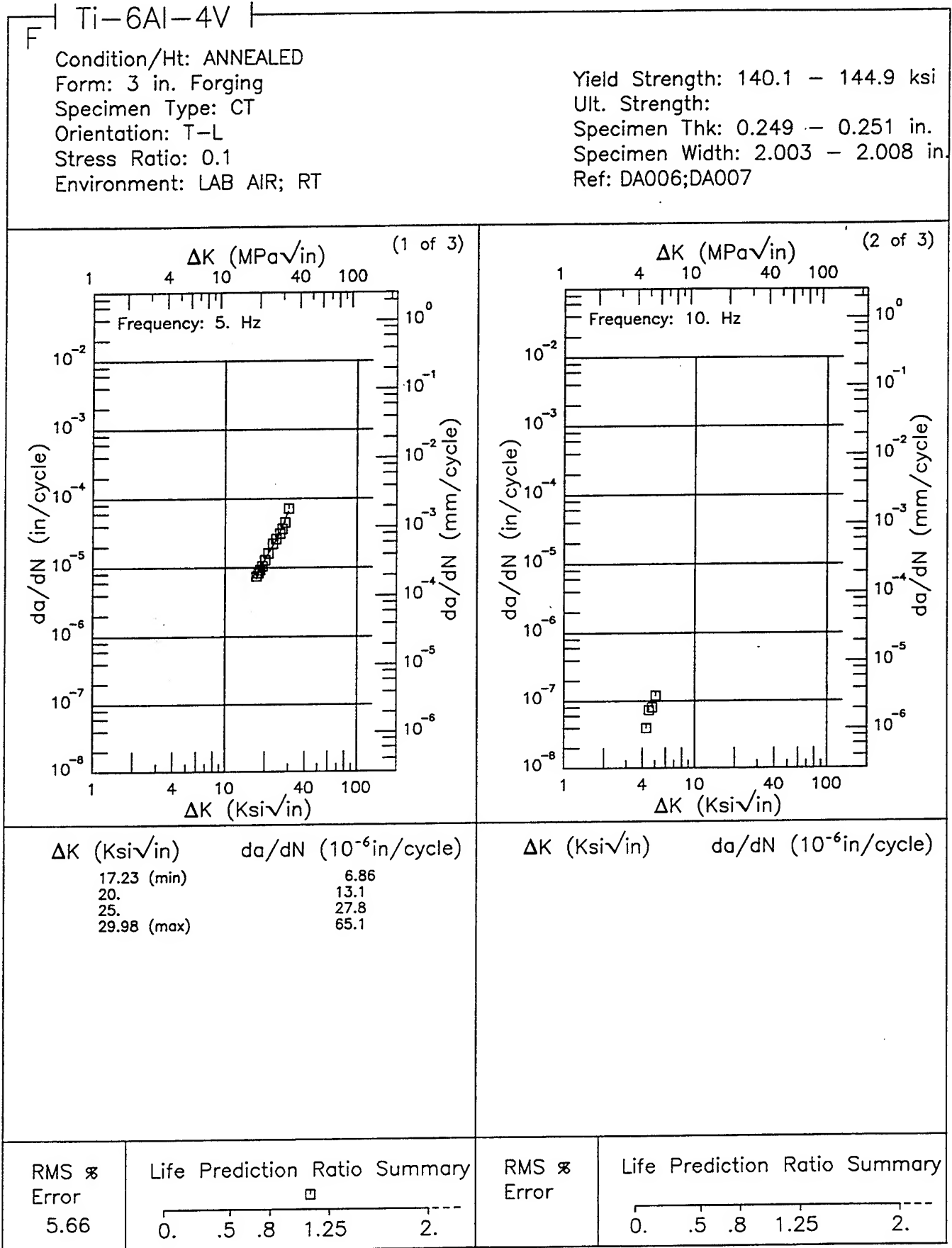


Figure 6.16.3.1.31

**This page intentionally left blank**



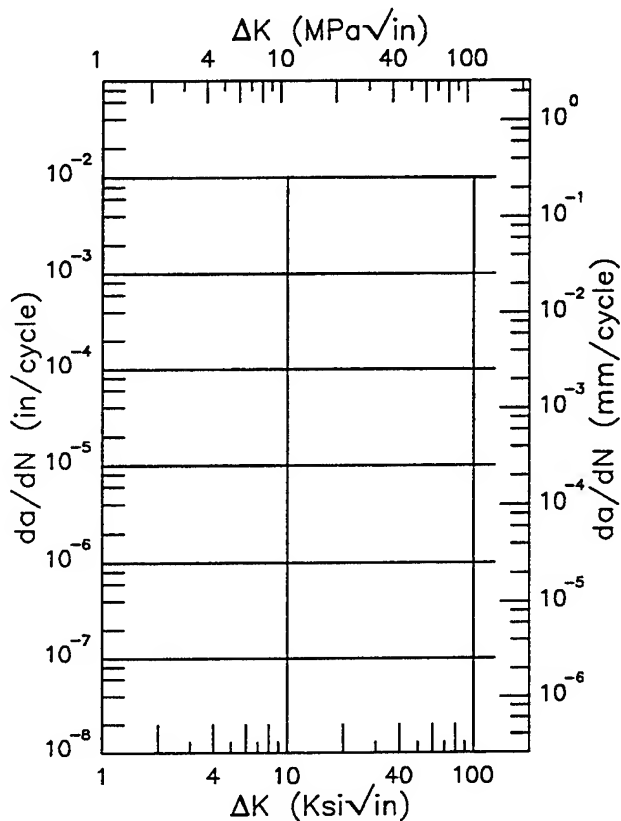
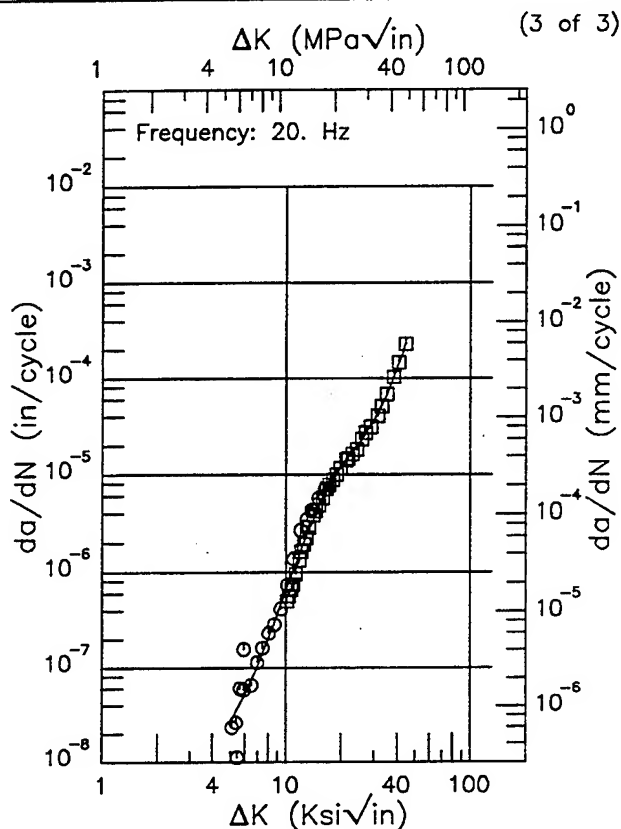


**Figure 6.16.3.1.32**

Ti-6Al-4V F

Condition/Ht: ANNEALED  
 Form: 3 in. Forging  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.1  
 Environment: LAB AIR; RT

Yield Strength: 140.1 - 144.9 ksi  
 Ult. Strength:  
 Specimen Thk: 0.249 - 0.251 in.  
 Specimen Width: 2.003 - 2.008 in.  
 Ref: DA006;DA007



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
5.08 (min)	0.0283
6.	0.0528
7.	0.105
8.	0.204
9.	0.373
10.	0.646
13.	2.41
16.	5.91
20.	12.1
25.	21.1
30.	36.1
35.	68.0
40.	134.
44.11 (max)	231.

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS %  
 Error  
 37.27

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

RMS %  
 Error

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

Figure 6.16.3.1.32 (Concluded)

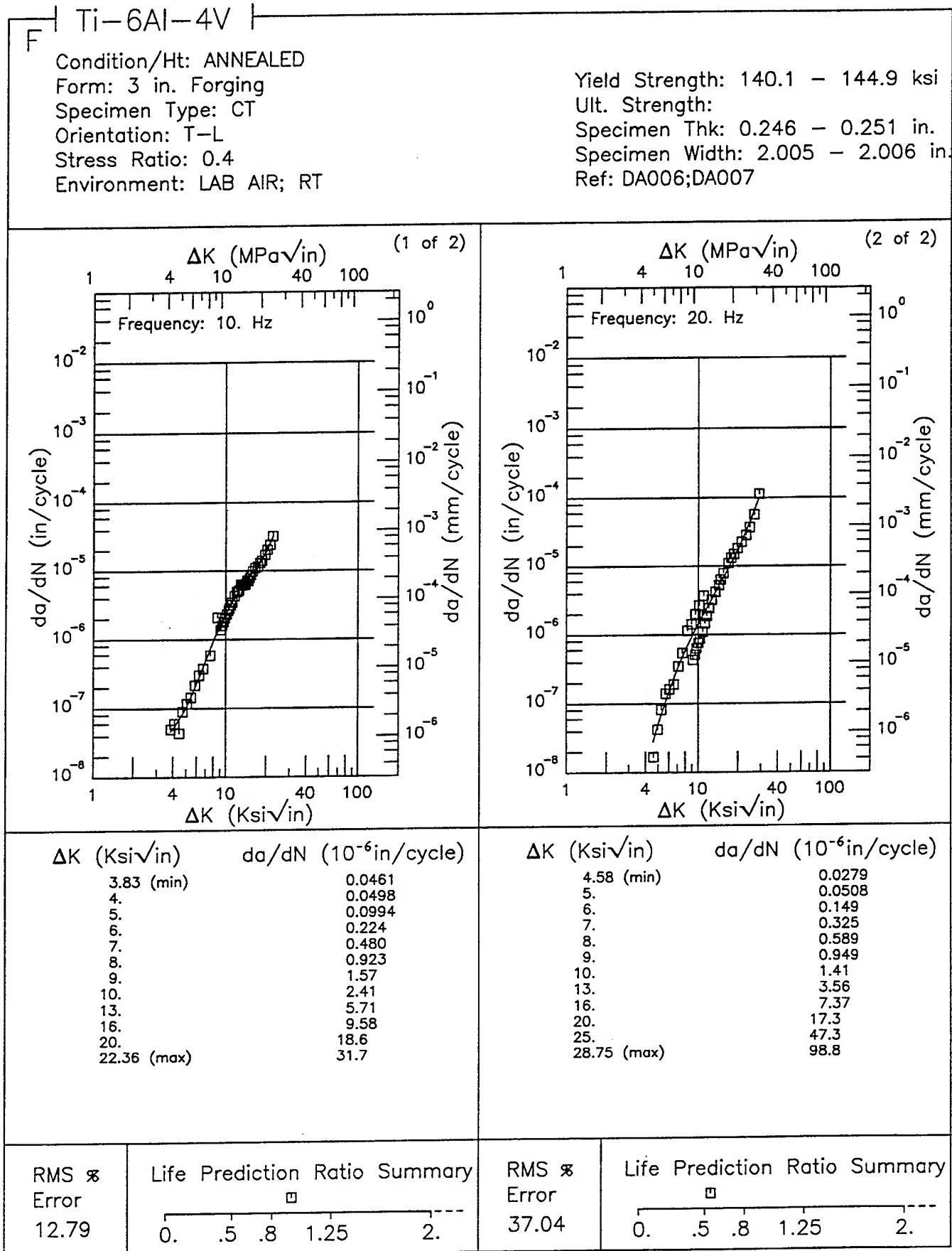


Figure 6.16.3.1.33

**This page intentionally left blank**

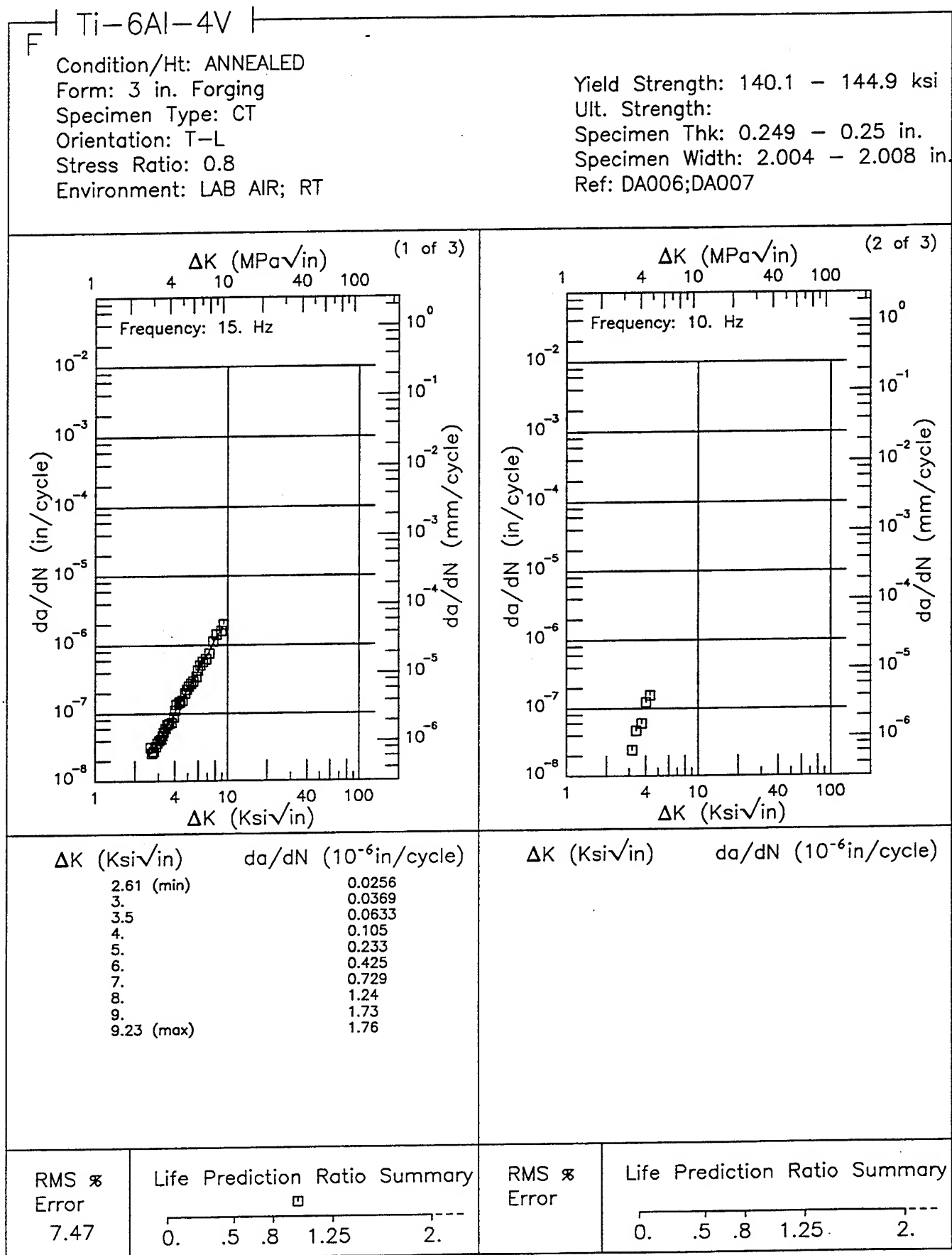


Figure 6.16.3.1.34

Condition/Ht: ANNEALED  
 Form: 3 in. Forging  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.8  
 Environment: LAB AIR; RT

Yield Strength: 140.1 - 144.9 ksi  
 Ult. Strength:  
 Specimen Thk: 0.249 - 0.25 in.  
 Specimen Width: 2.004 - 2.008 in.  
 Ref: DA006;DA007

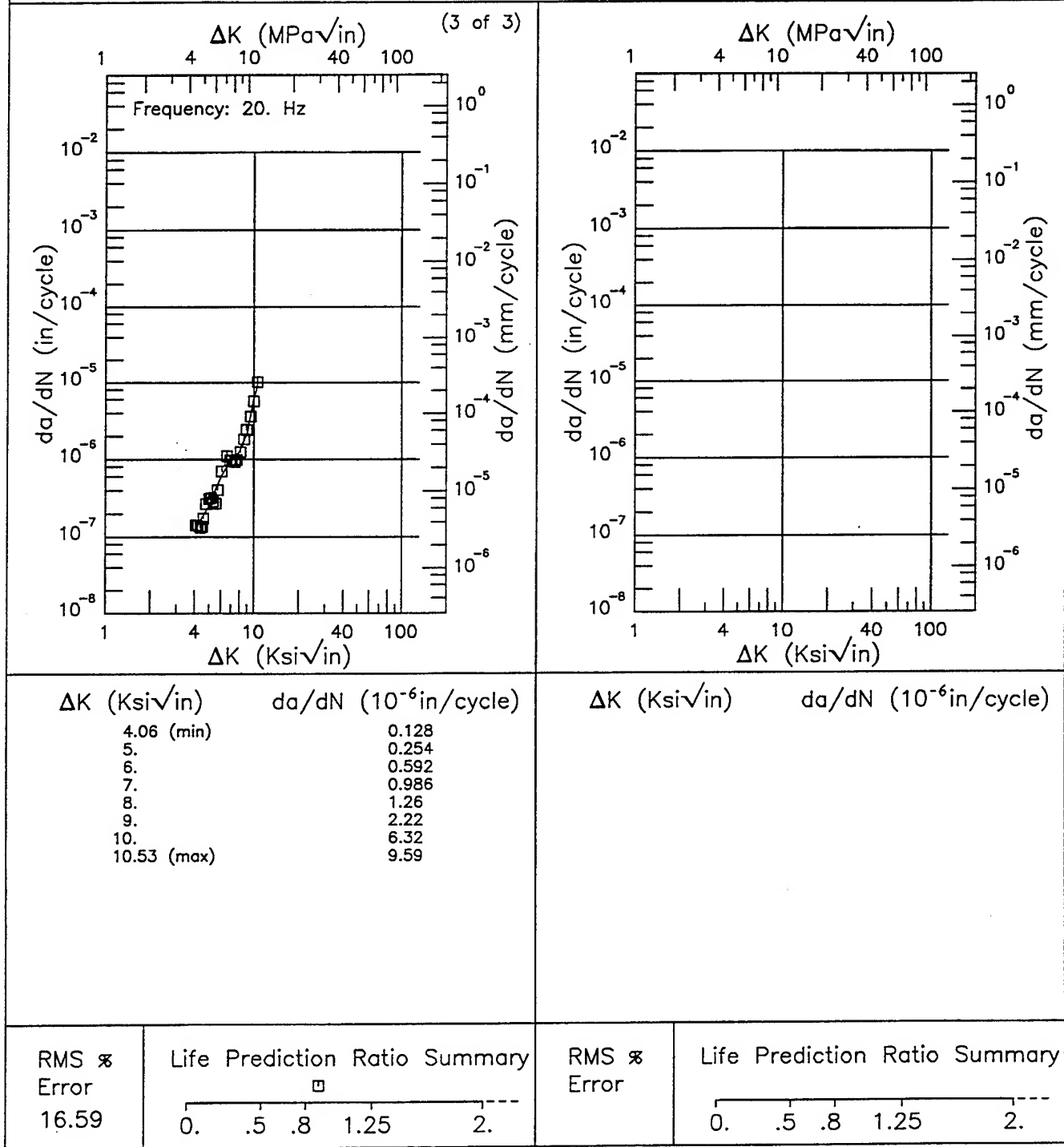


Figure 6.16.3.1.34 (Concluded)

R

Ti-6Al-4V

Condition/Ht: ANNEALED

Form: 3 in. Forging

Specimen Type: CCP (max load specified)

Orientation: L-T

Frequency: 5 Hz

Environment: LAB AIR; RT

Yield Strength: 131.7 ksi

Ult. Strength:

Specimen Thk: 0.205 in.

Specimen Width: 4.018 in.

Ref: DA006

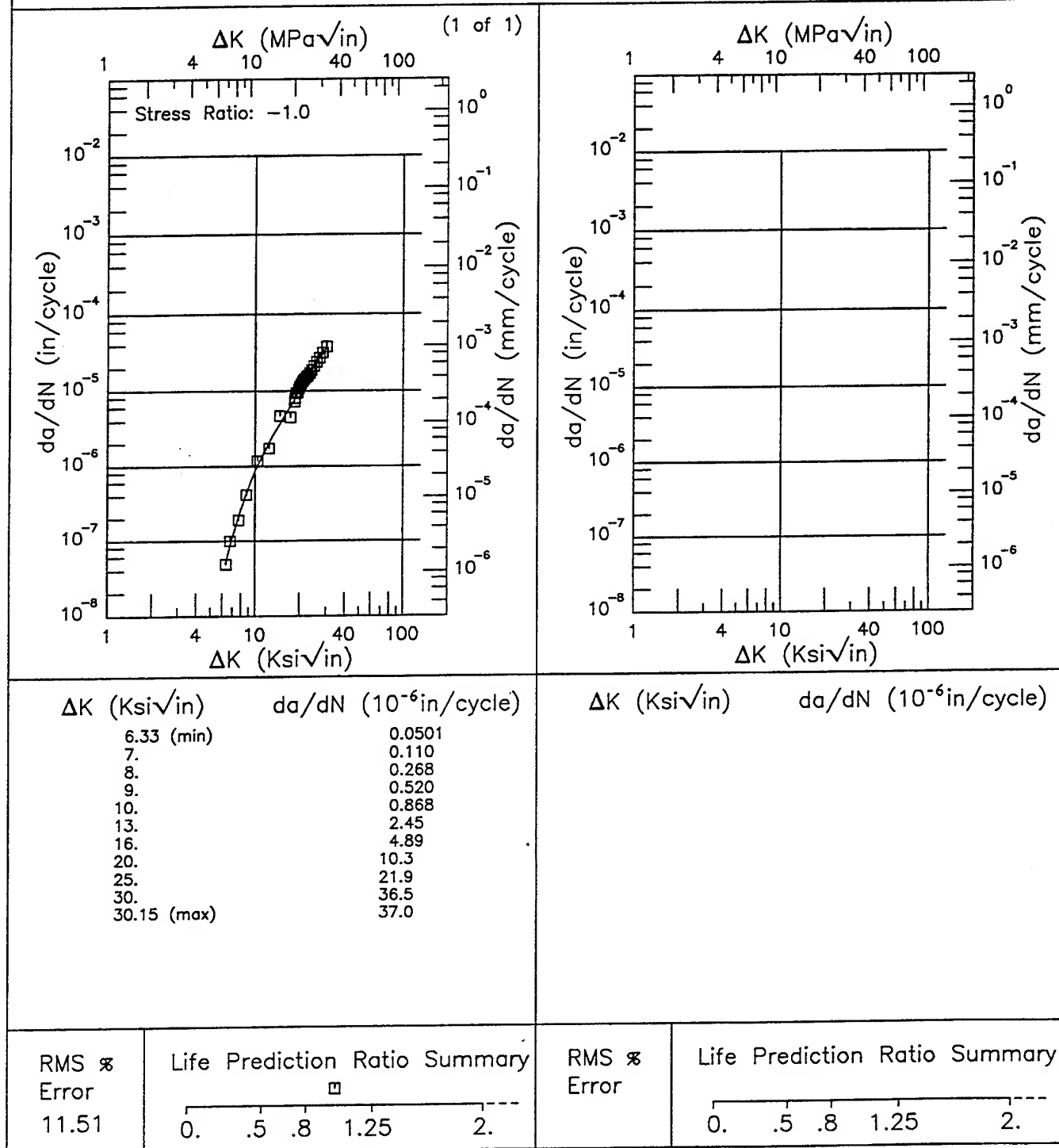


Figure 6.16.3.1.35

Condition/Ht: ANNEALED AT 1375F 3HRS AC  
 Form: 2.75 in. Plate  
 Specimen Type: WOL  
 Orientation: L-T  
 Frequency: 10 - 20 Hz  
 Environment: LAB AIR; RT

Yield Strength: 129 ksi  
 Ult. Strength: 139 ksi  
 Specimen Thk: 1.25 in.  
 Specimen Width: 5 in.  
 Ref: MA003

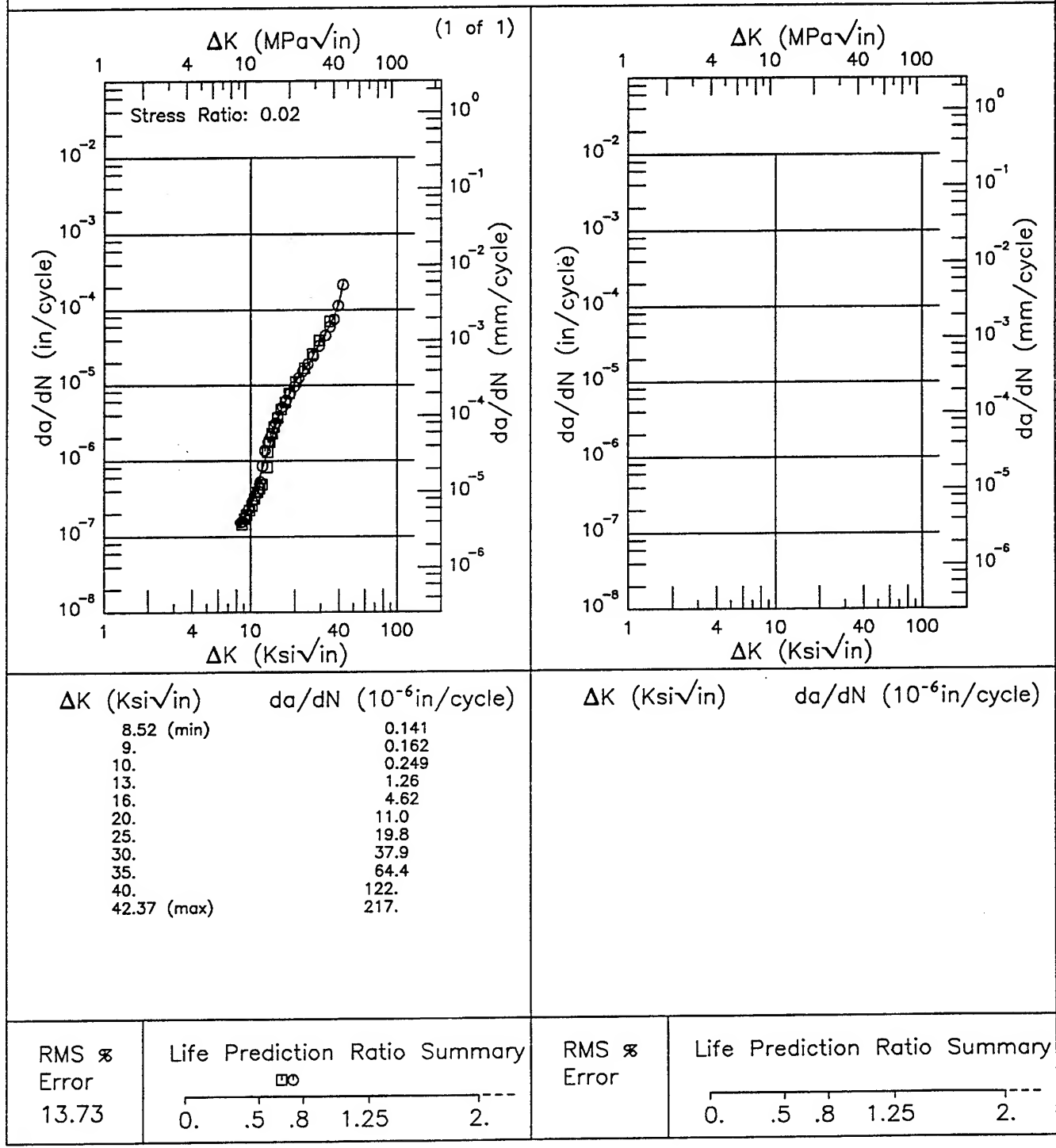
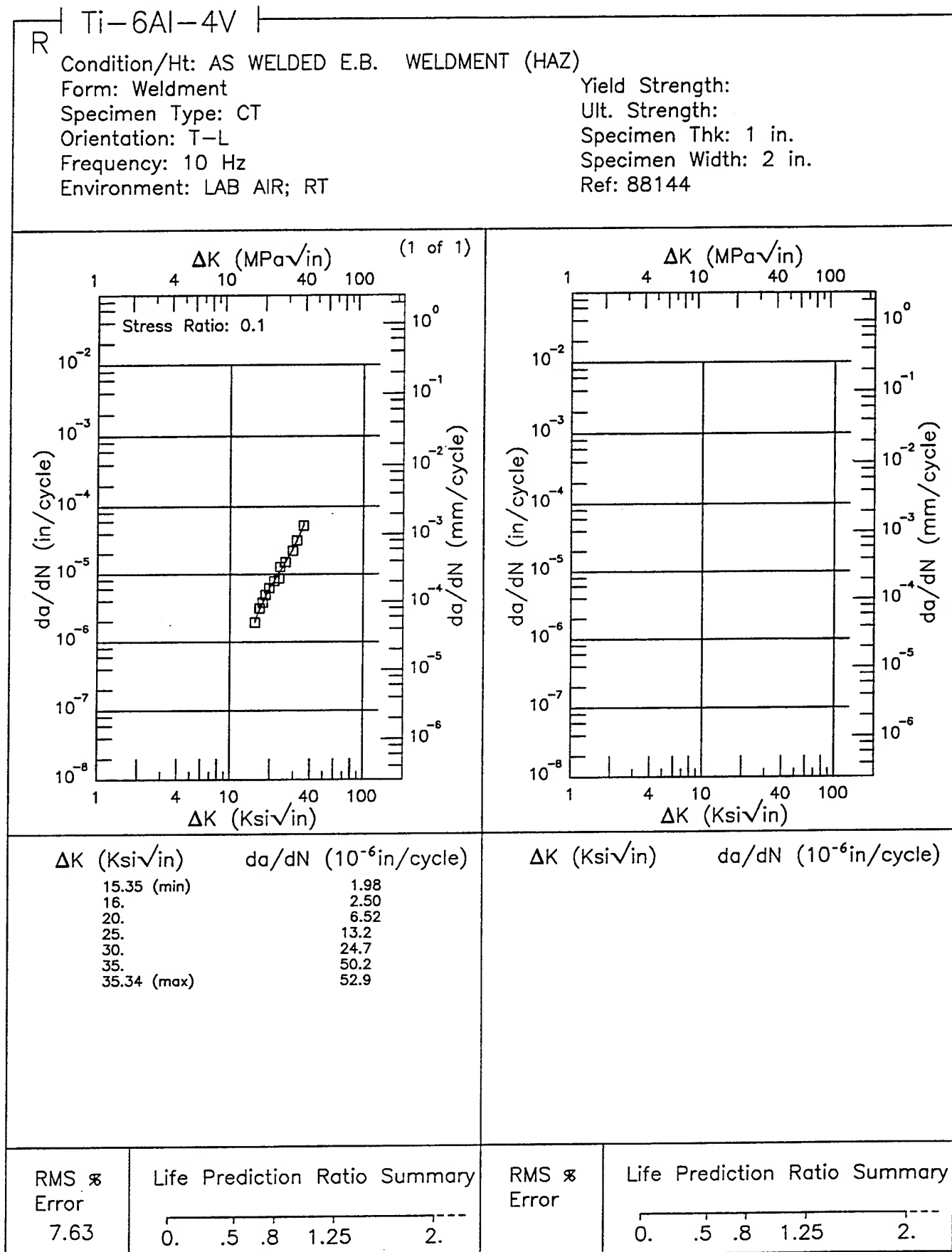


Figure 6.16.3.1.36





**Figure 6.16.3.1.37**

Condition/Ht: AS WELDED E.B. WELDMENT (WELD ZONE)

Form: Weldment

Specimen Type: CT

Orientation: T-L

Frequency: 10 Hz

Environment: LAB AIR; RT

Yield Strength:

Ult. Strength:

Specimen Thk: 1 in.

Specimen Width: 2 in.

Ref: 88144

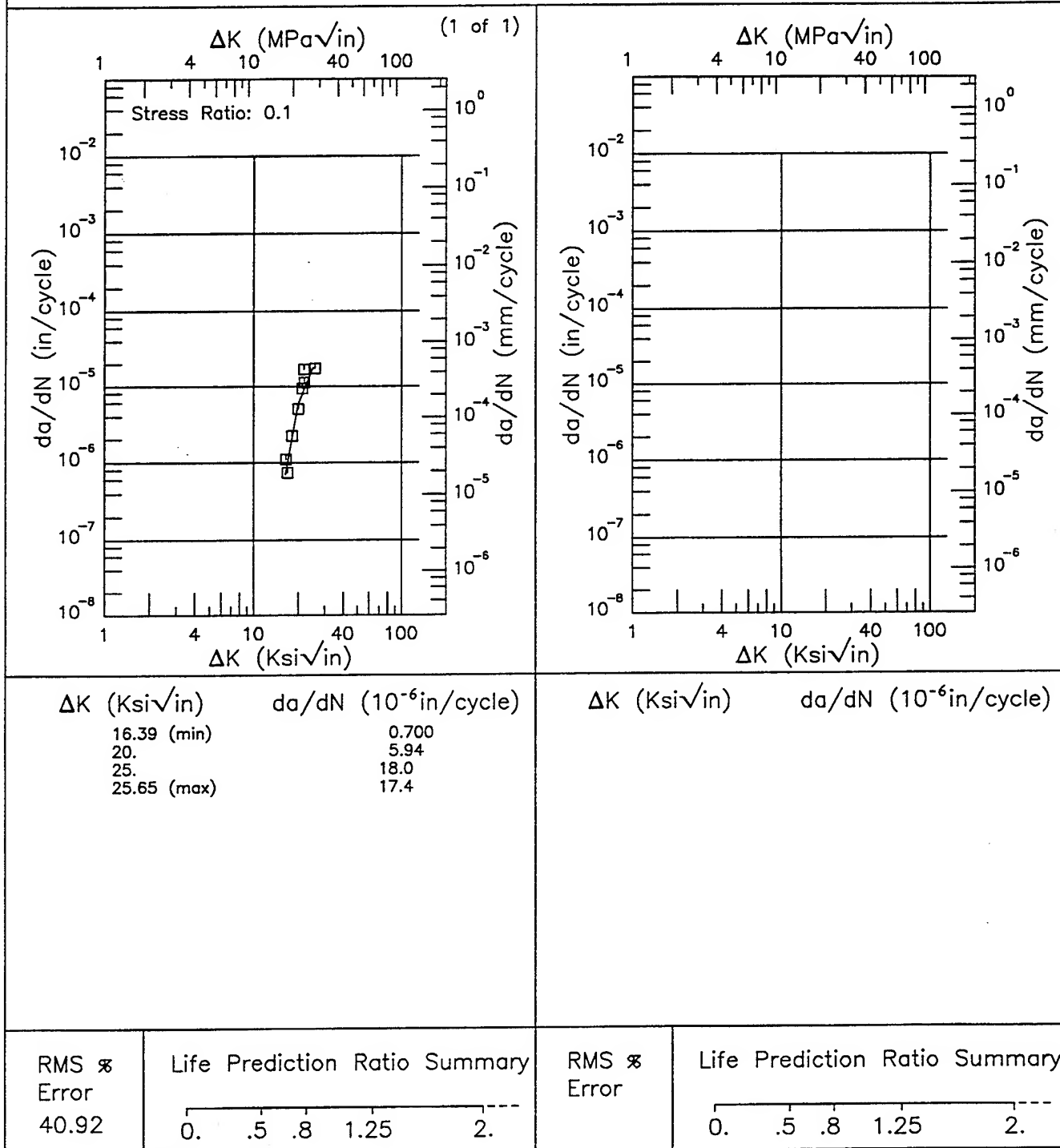


Figure 6.16.3.1.38

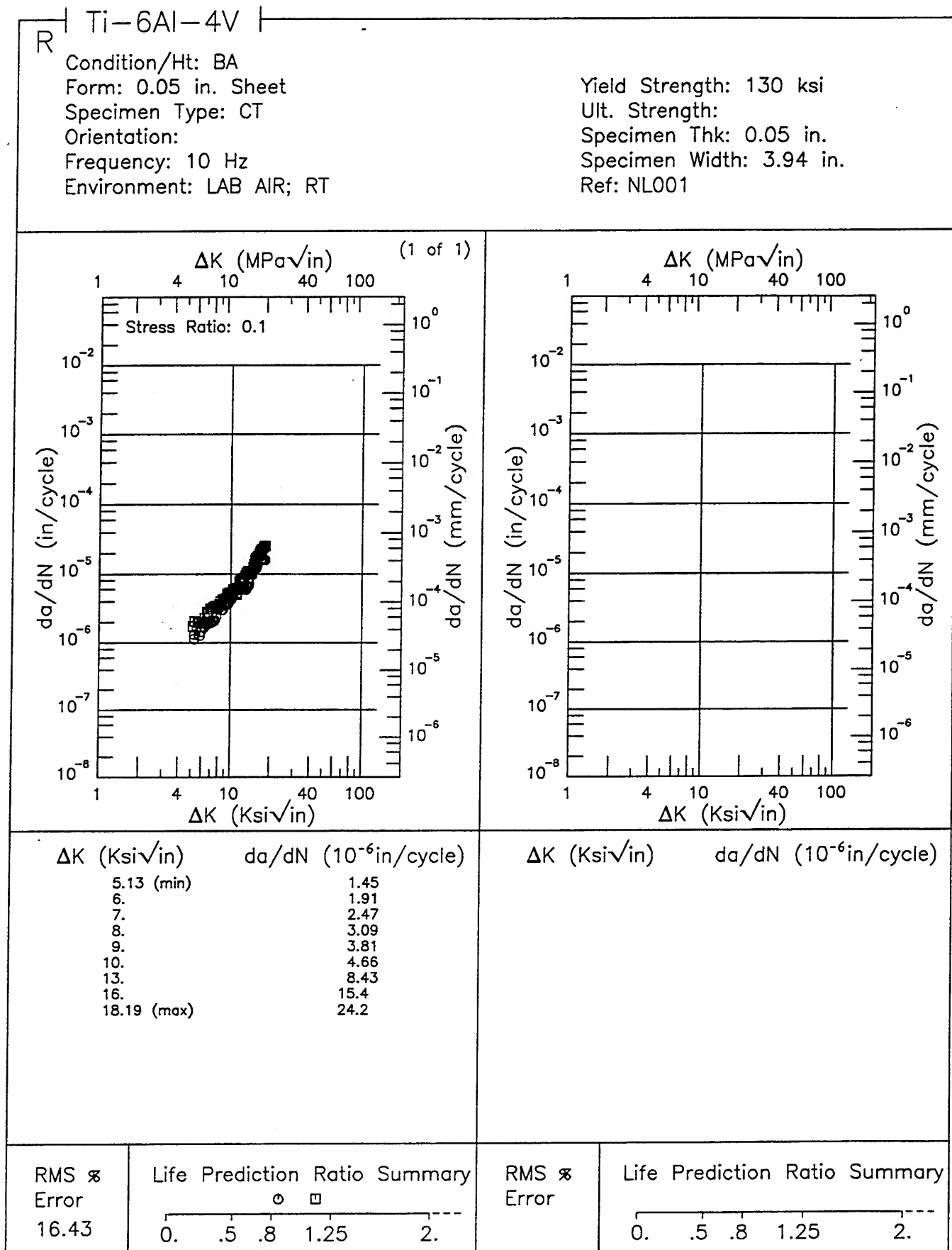


Figure 6.16.3.1.39

**This page intentionally left blank**

R

Ti-6Al-4V

Condition/Ht: BA  
 Form: 0.05 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation:  
 Frequency: 10 Hz  
 Environment: LAB AIR; RT

Yield Strength: 130 ksi  
 Ult. Strength:  
 Specimen Thk: 0.05 in.  
 Specimen Width: 3.15 in.  
 Ref: NL001

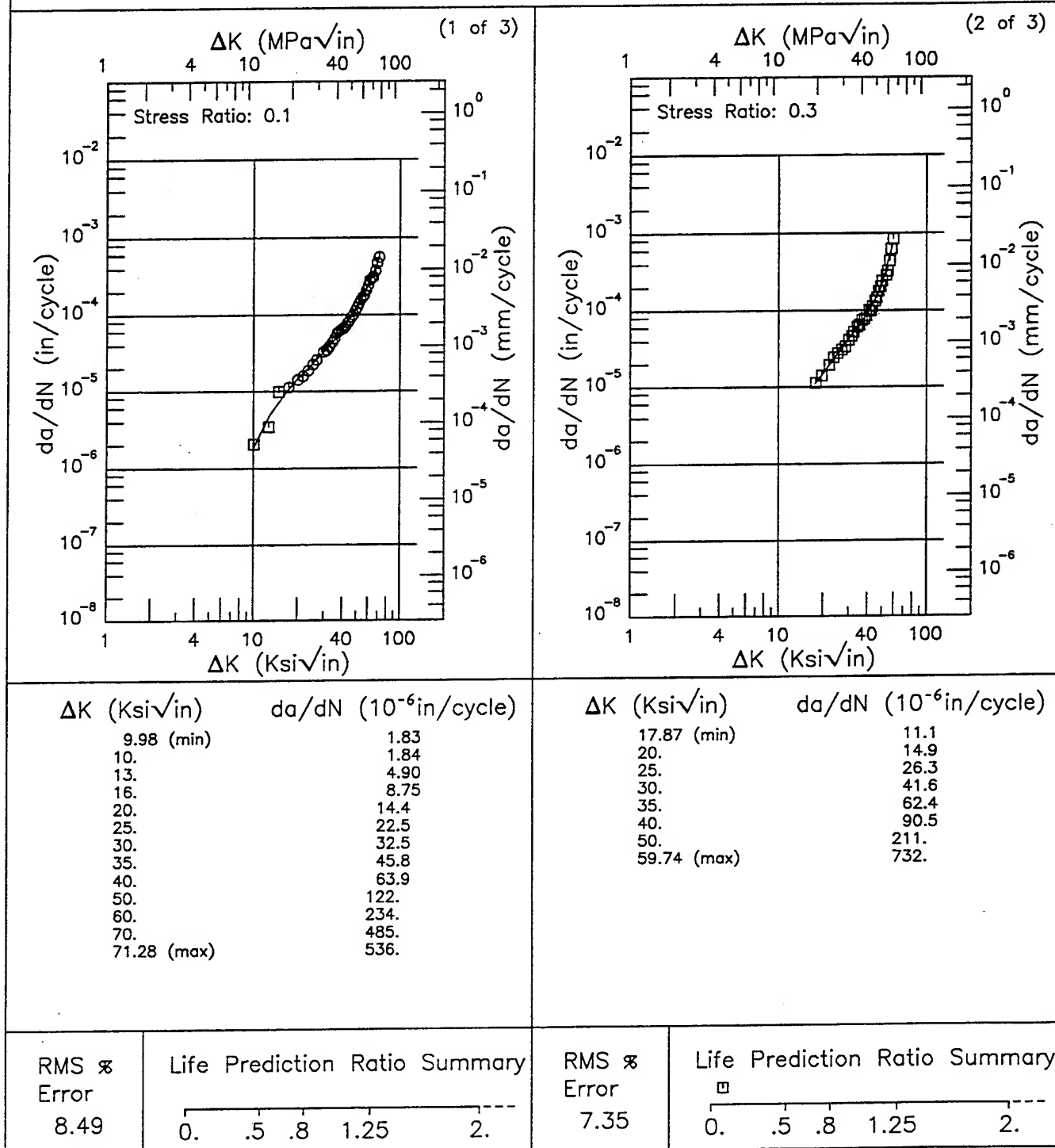


Figure 6.16.3.1.40

Condition/Ht: BA  
 Form: 0.05 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation:  
 Frequency: 10 Hz  
 Environment: LAB AIR; RT

Yield Strength: 130 ksi  
 Ult. Strength:  
 Specimen Thk: 0.05 in.  
 Specimen Width: 3.15 in.  
 Ref: NL001

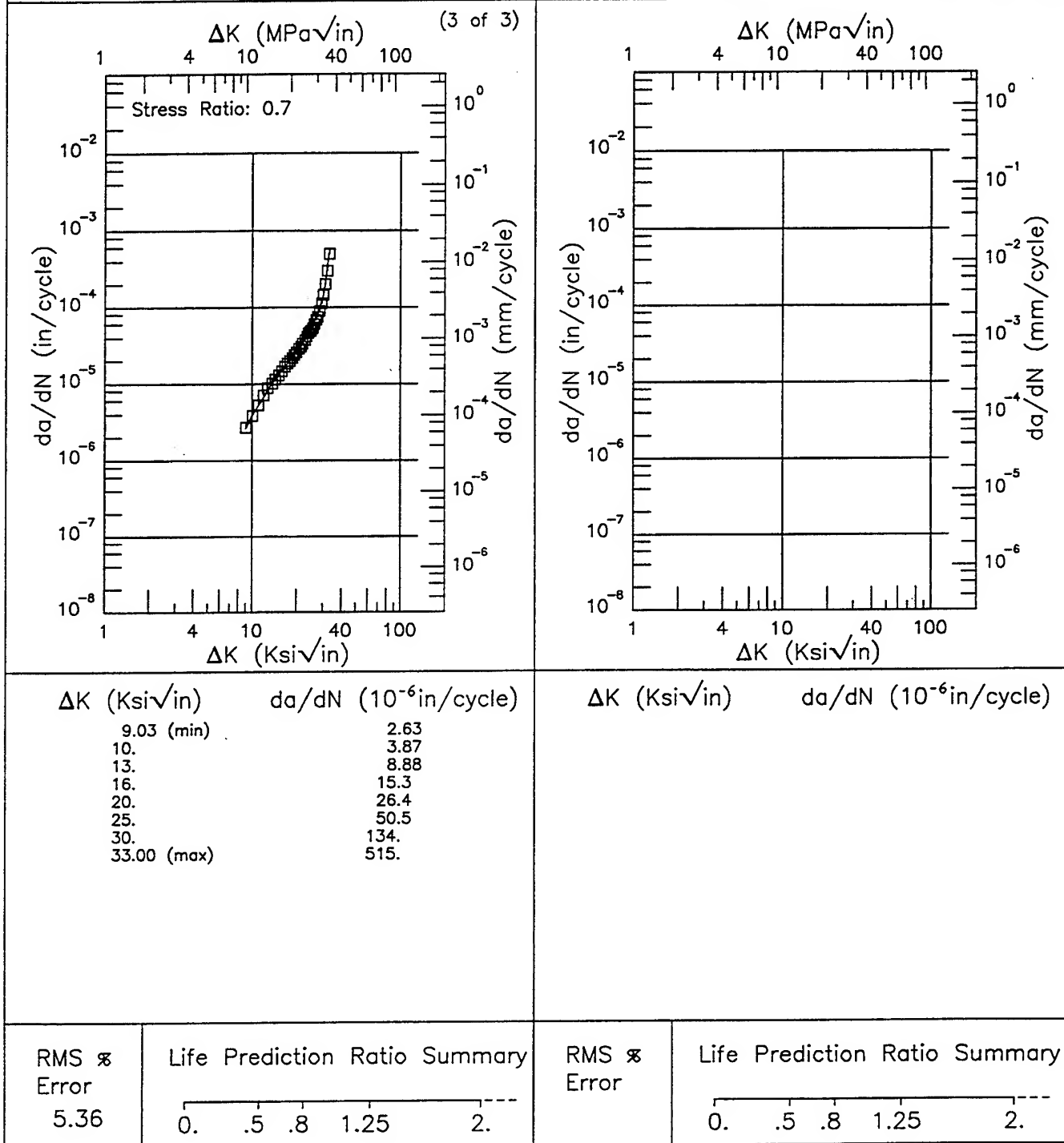
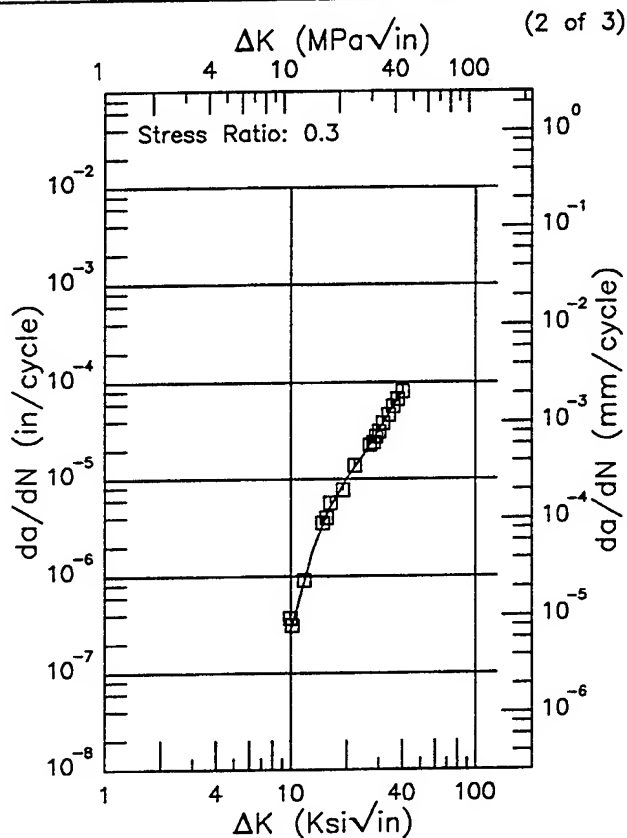
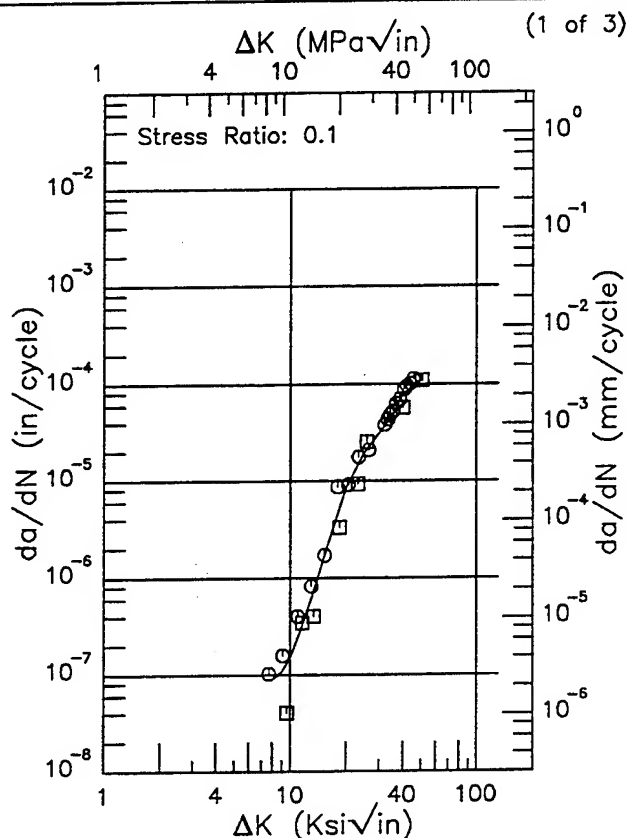


Figure 6.16.3.1.40 (Concluded)

R | Ti-6Al-4V |  
 Condition/Ht: BA  
 Form: 0.76 - 2.79 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 6 Hz  
 Environment: DRY AIR; RT

Yield Strength: 116.3 ksi  
 Ult. Strength: 125.7 ksi  
 Specimen Thk: 0.747 - 0.762 in.  
 Specimen Width: 4.993 - 5.008 in.  
 Ref: 88575



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
7.64 (min)	0.0896
8.	0.0896
9.	0.107
10.	0.152
13.	0.607
16.	2.29
20.	8.39
25.	19.8
30.	31.0
35.	47.4
40.	78.6
50.	111.
50.68 (max)	108.

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
9.89 (min)	0.265
10.	0.290
13.	1.73
16.	4.79
20.	10.1
25.	18.3
30.	31.9
35.	52.9
39.92 (max)	79.6

RMS %  
 Error  
 32.89

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
 Error  
 10.64

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 6.16.3.1.41

Ti-6Al-4V

R

Condition/Ht: BA

Form: 0.76 - 2.79 in. Plate

Specimen Type: CT

Orientation: L-T

Frequency: 6 Hz

Environment: DRY AIR; RT

Yield Strength: 116.3 ksi

Ult. Strength: 125.7 ksi

Specimen Thk: 0.747 - 0.762 in.

Specimen Width: 4.993 - 5.008 in.

Ref: 88575

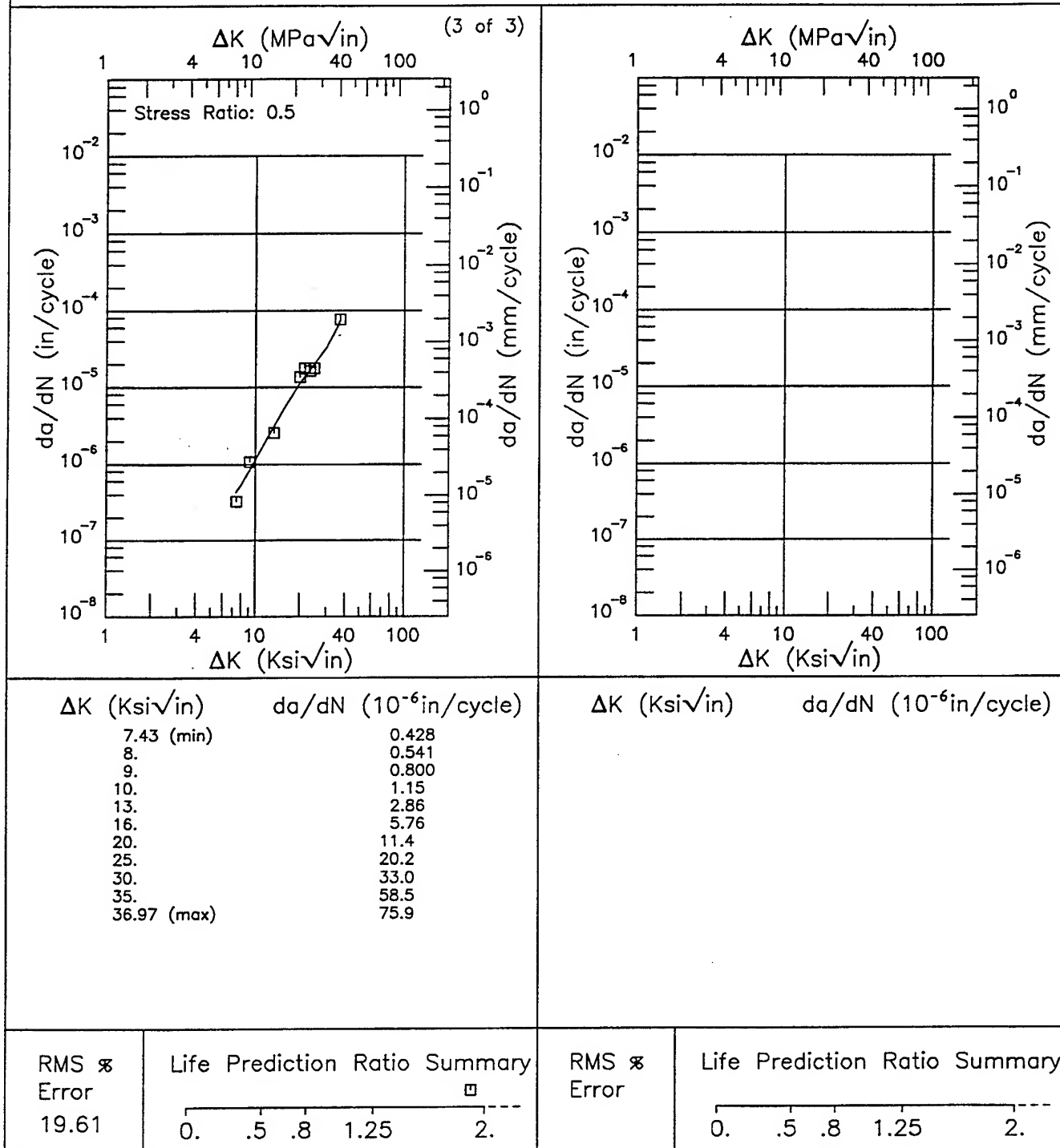


Figure 6.16.3.1.41 (Concluded)



R

Ti-6Al-4V

Condition/Ht: BA

Form: 2.25 in. Plate

Specimen Type: CT

Orientation: L-T

Frequency: 0.1 Hz

Environment: H.H.A.; RT

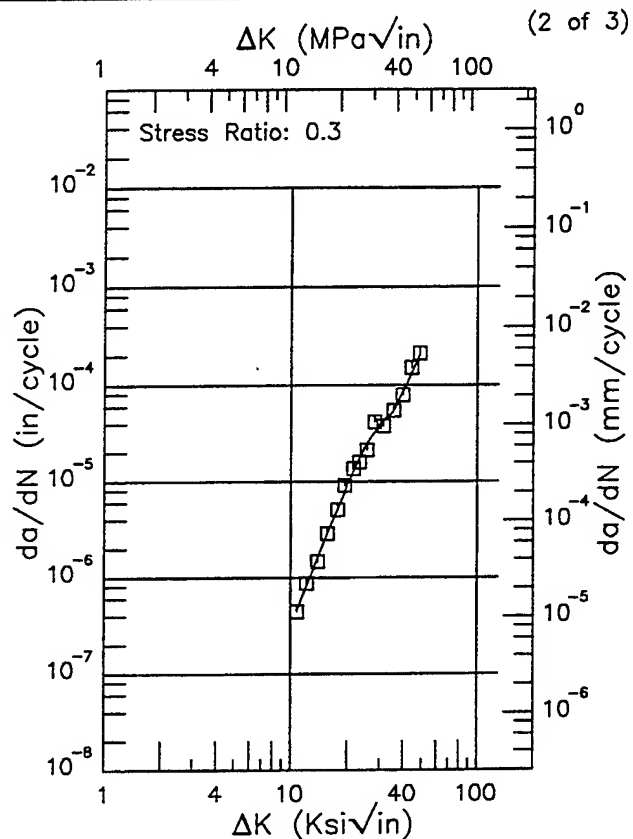
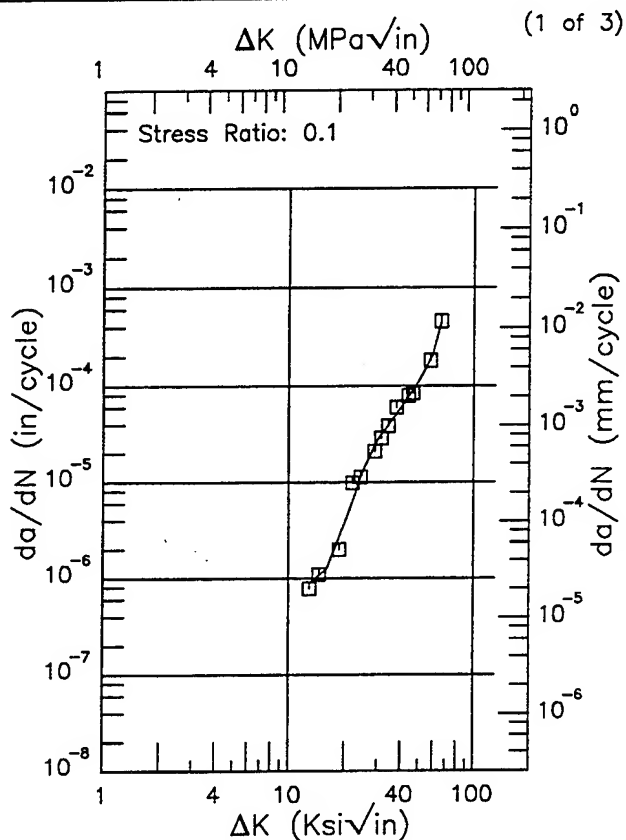
Yield Strength: 117 ksi

Ult. Strength: 129.4 ksi

Specimen Thk: 0.749 - 0.753 in.

Specimen Width: 5.009 - 5.013 in.

Ref: GD007



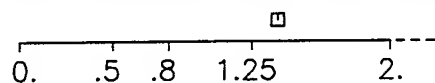
$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.84 (min)	0.891
13.	0.881
16.	1.25
20.	3.75
25.	13.0
30.	27.4
35.	42.3
40.	59.3
50.	112.
60.	217.
66.20 (max)	454.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
10.82 (min)	0.464
13.	1.13
16.	3.17
20.	9.28
25.	23.4
30.	39.1
35.	52.2
40.	86.6
48.80 (max)	210.

RMS %  
Error

17.91

Life Prediction Ratio Summary

RMS %  
Error

11.30

Life Prediction Ratio Summary

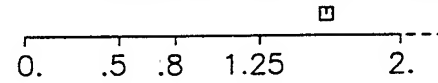


Figure 6.16.3.1.42

Ti-6Al-4V R

Condition/Ht: BA  
Form: 2.25 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Frequency: 0.1 Hz  
Environment: H.H.A.; RT

Yield Strength: 117 ksi  
Ult. Strength: 129.4 ksi  
Specimen Thk: 0.749 - 0.753 in.  
Specimen Width: 5.009 - 5.013 in.  
Ref: GD007

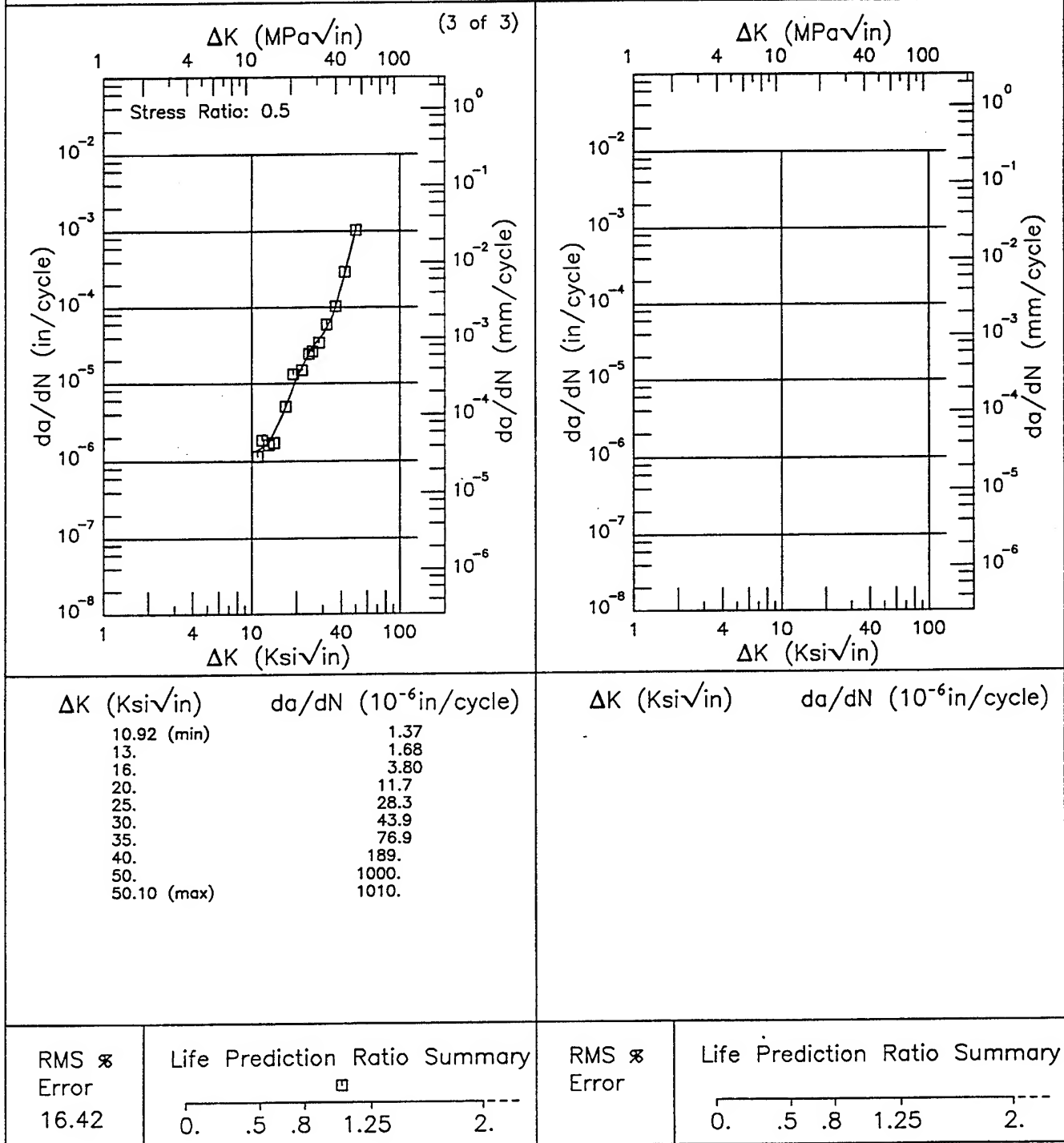


Figure 6.16.3.1.42 (Concluded)

R

Ti-6Al-4V

Condition/Ht: BA

Form: 0.75 - 0.76 in. Plate

Specimen Type: CT

Orientation: L-T

Frequency: 1 Hz

Environment: S.T.W.; RT

Yield Strength: 116.3 ksi

Ult. Strength: 125.7 ksi

Specimen Thk: 0.746 - 0.751 in.

Specimen Width: 4.986 - 5.019 in.

Ref: 88575

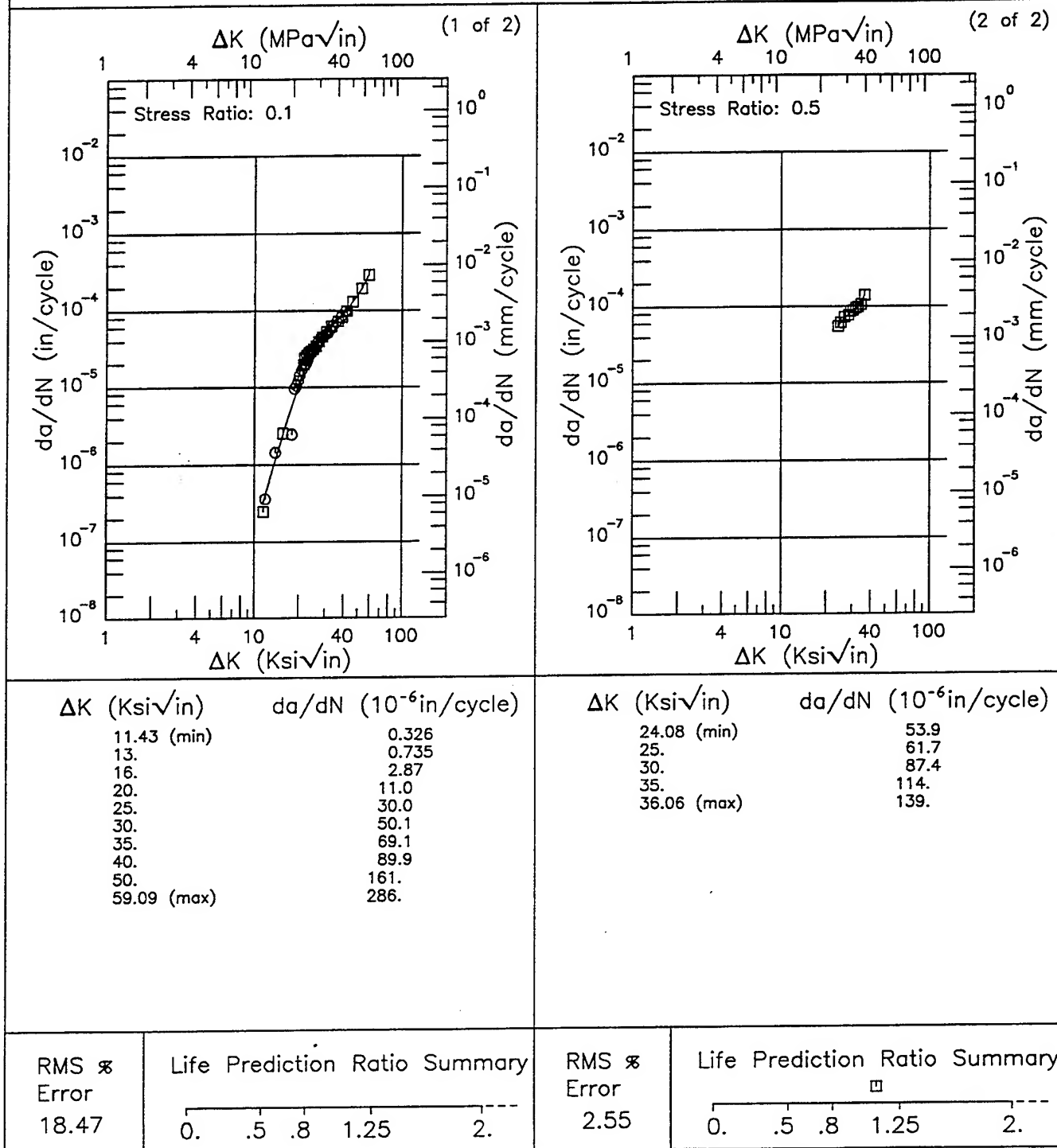


Figure 6.16.3.1.43

Condition/Ht: BA  
 Form: 0.75 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 0.1 Hz  
 Environment: S.T.W.; RT

Yield Strength: 116.3 ksi  
 Ult. Strength: 125.7 ksi  
 Specimen Thk: 0.75 in.  
 Specimen Width: 5.008 in.  
 Ref: 88575

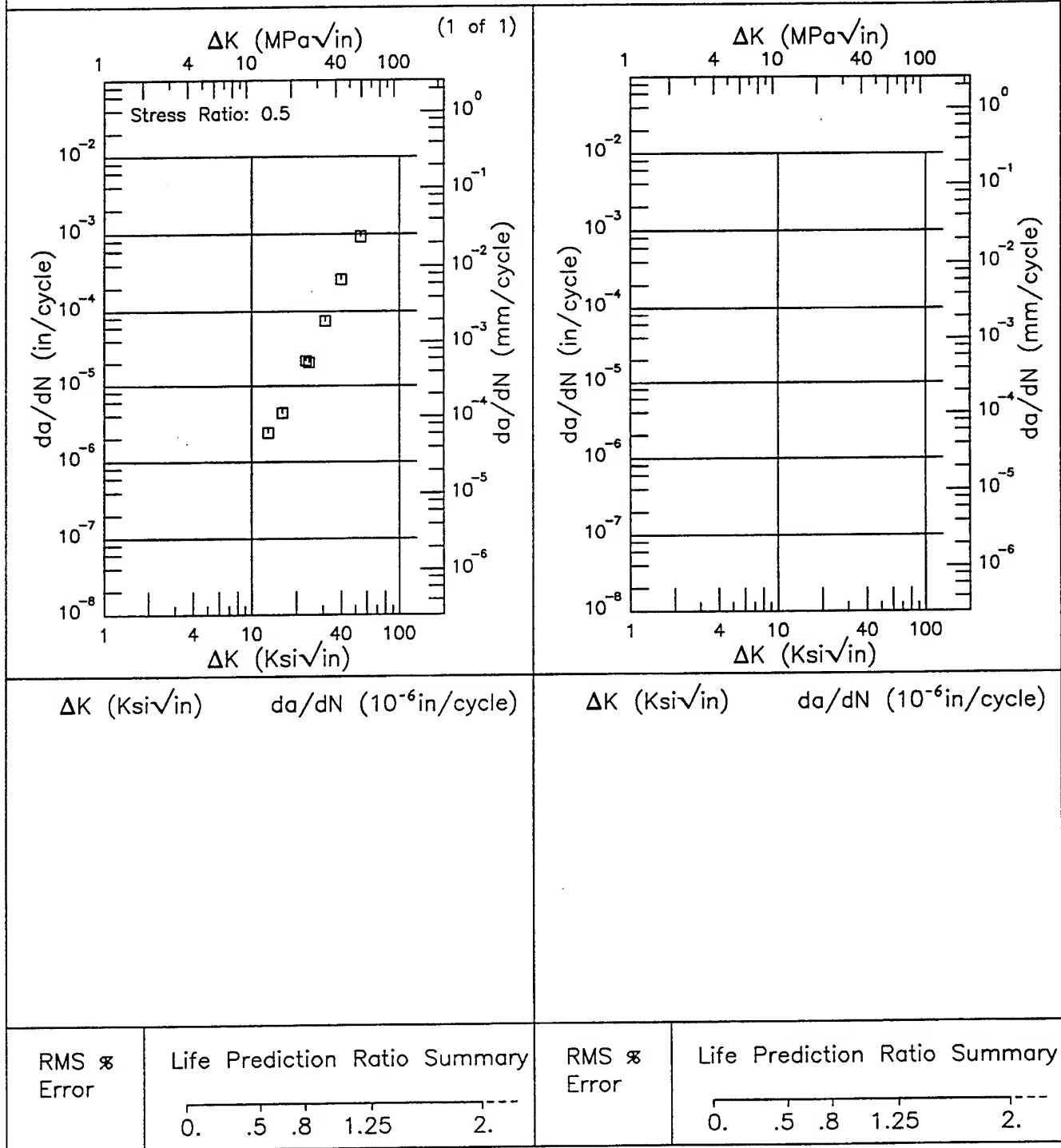
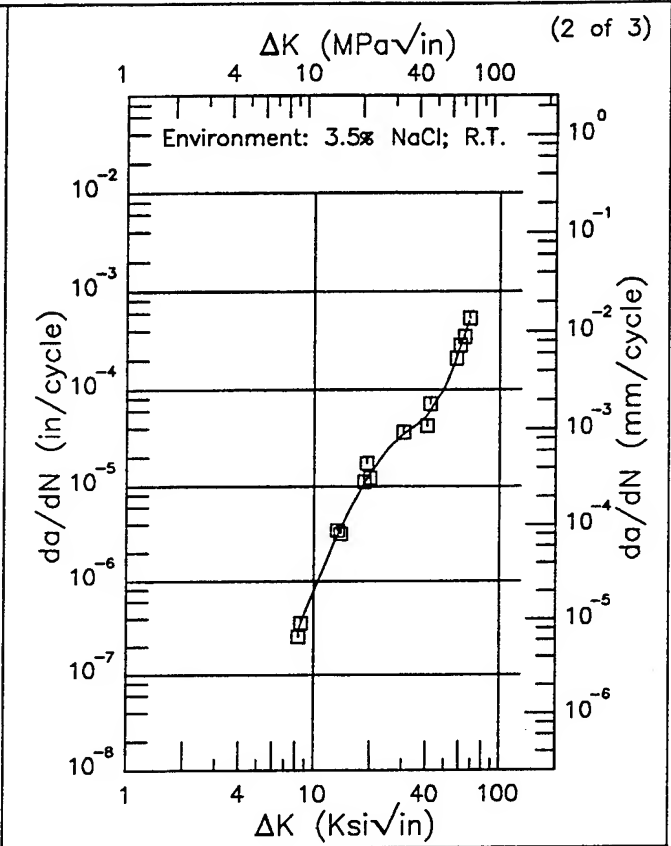
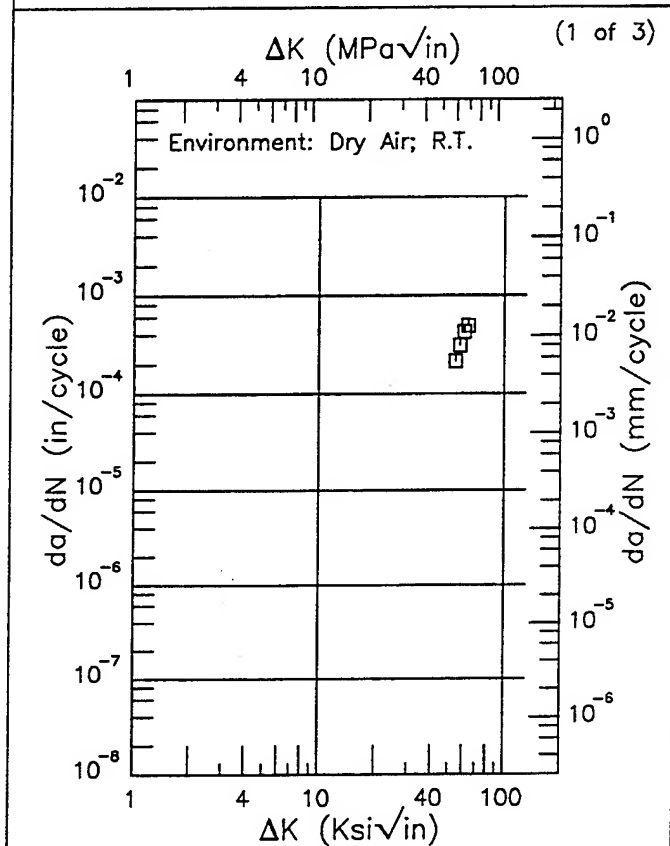


Figure 6.16.3.1.44

E | Ti-6Al-4V |

Condition/Ht: BA  
 Form: 0.63 in. Plate  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.1  
 Frequency: 10 Hz

Yield Strength: 124.5 ksi  
 Ult. Strength: 136.4 ksi  
 Specimen Thk: 0.66 in.  
 Specimen Width: 2.55 - 2.554 in.  
 Ref: 90981



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.24 (min)	0.294
9.	0.464
10.	0.787
13.	2.69
16.	6.31
20.	13.6
25.	24.6
30.	34.1
35.	42.0
40.	52.4
50.	103.
60.	254.
68.19 (max)	499.

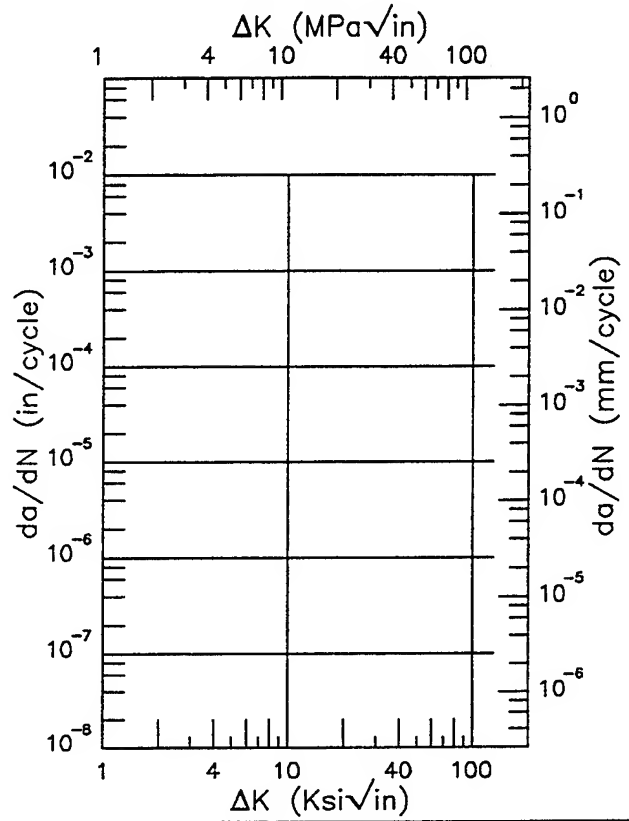
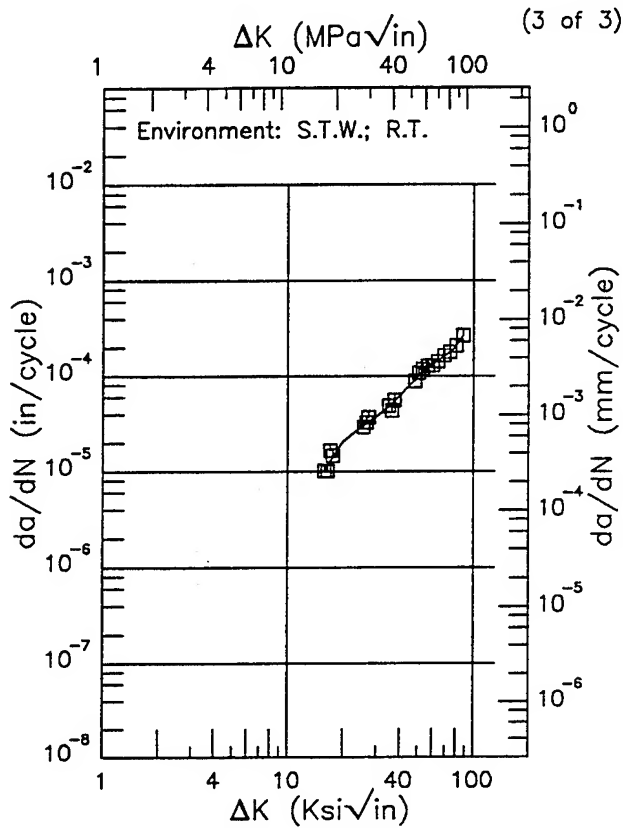
$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.24 (min)	0.294
9.	0.464
10.	0.787
13.	2.69
16.	6.31
20.	13.6
25.	24.6
30.	34.1
35.	42.0
40.	52.4
50.	103.
60.	254.
68.19 (max)	499.

RMS % Error	Life Prediction Ratio Summary	RMS % Error	Life Prediction Ratio Summary
	0. .5 .8 1.25 2. ---	16.33	0. .5 .8 1.25 2. --- □

Figure 6.16.3.1.45

Condition/Ht: BA  
Form: 0.63 in. Plate  
Specimen Type: CT  
Orientation: T-L  
Stress Ratio: 0.1  
Frequency: 10 Hz

Yield Strength: 124.5 ksi  
Ult. Strength: 136.4 ksi  
Specimen Thk: 0.66 in.  
Specimen Width: 2.55 - 2.554 in.  
Ref: 90981



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
15.85 (min)	10.2
16.	10.6
20.	20.7
25.	29.9
30.	37.6
35.	47.7
40.	62.1
50.	98.9
60.	133.
70.	164.
80.	205.
87.57 (max)	264.

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS %  
Error  
9.22

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 6.16.3.1.45 (Concluded)

E

Ti-6Al-4V

Condition/Ht: BA

Form: 0.63 in. Plate

Specimen Type: CT

Orientation: T-L

Stress Ratio: 0.1

Frequency: 1 Hz

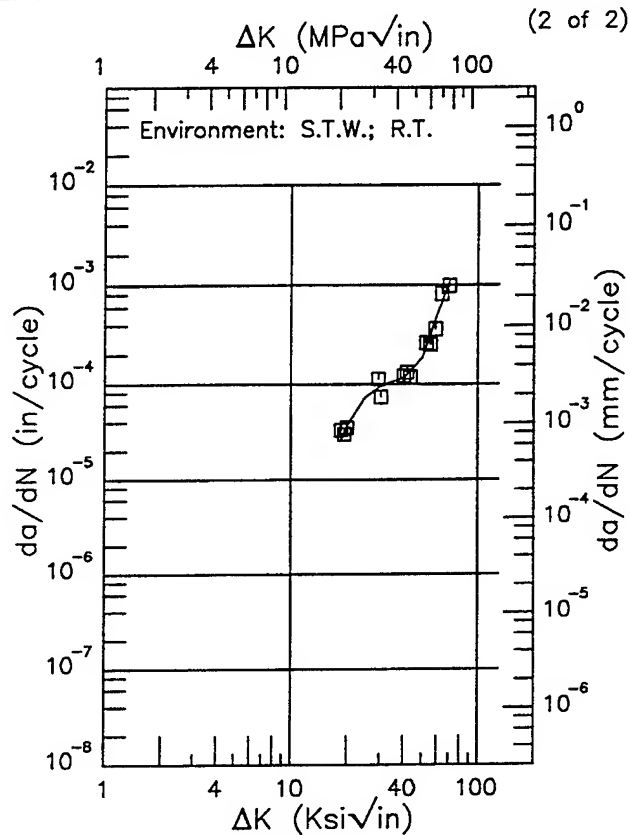
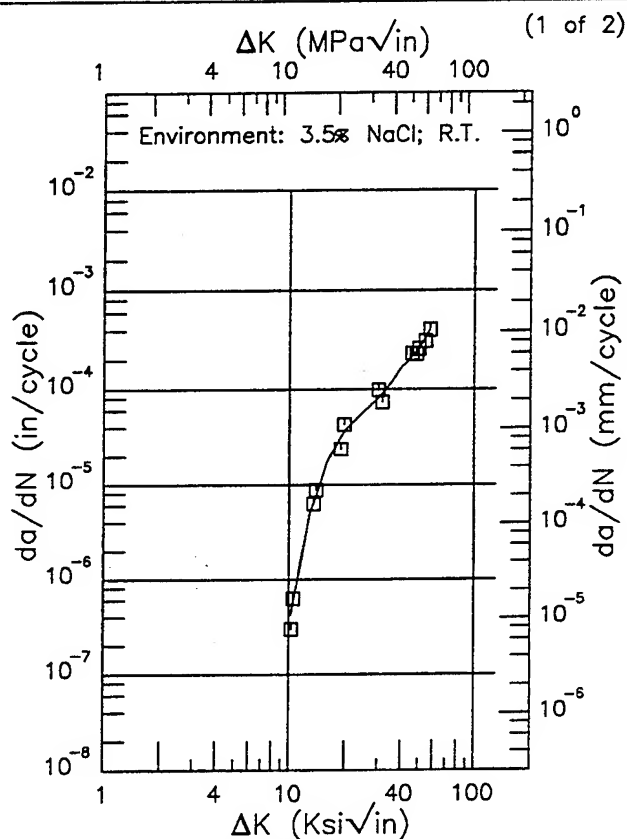
Yield Strength: 124.5 ksi

Ult. Strength: 136.4 ksi

Specimen Thk: 0.66 in.

Specimen Width: 2.55 - 2.554 in.

Ref: 90981



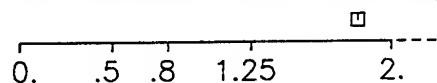
$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
10.21 (min)	0.423
13.	4.99
16.	17.5
20.	37.4
25.	58.6
30.	81.2
35.	115.
40.	165.
50.	256.
57.34 (max)	396.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
18.51 (min)	25.4
20.	36.7
25.	72.5
30.	94.5
35.	106.
40.	115.
50.	185.
60.	502.
69.64 (max)	1052.

RMS %  
Error

15.95

Life Prediction Ratio Summary

RMS %  
Error

16.82

Life Prediction Ratio Summary

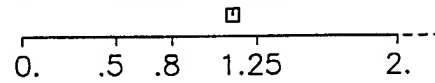


Figure 6.16.3.1.46

Condition/Ht: BA  
 Form: 0.63 in. Plate  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.1  
 Frequency: 0.1 Hz

Yield Strength: 124.5 ksi  
 Ult. Strength: 136.4 ksi  
 Specimen Thk: 0.66 in.  
 Specimen Width: 2.55 in.  
 Ref: 90981

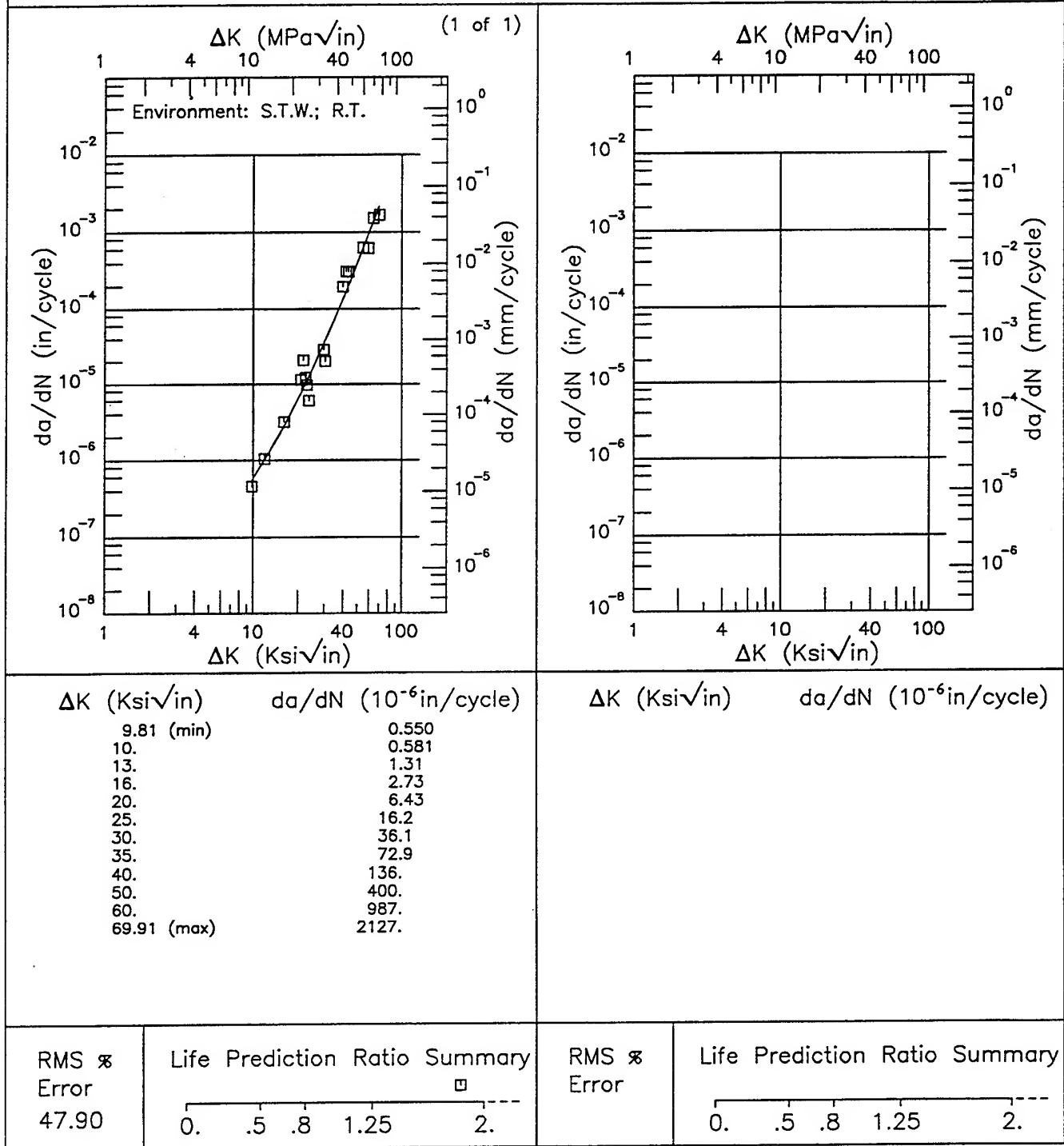


Figure 6.16.3.1.47



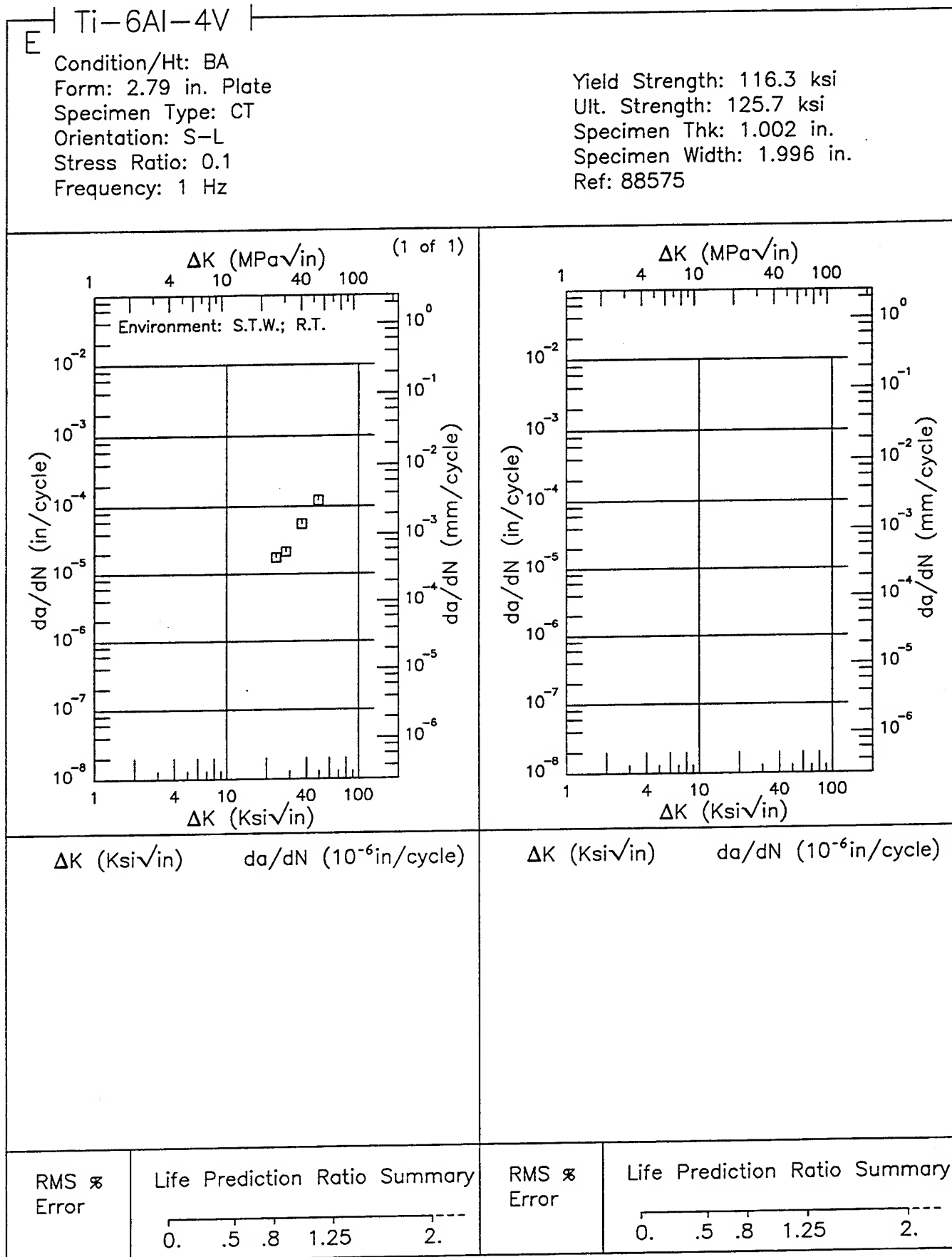


Figure 6.16.3.1.48

Condition/Ht: BA  
 Form: 1 in. Plate  
 Specimen Type: DCB  
 Orientation: T-L  
 Frequency: 0.1 Hz  
 Environment: DIST WATER; RT

Yield Strength:  
 Ult. Strength:  
 Specimen Thk:  
 Specimen Width:  
 Ref: 88140

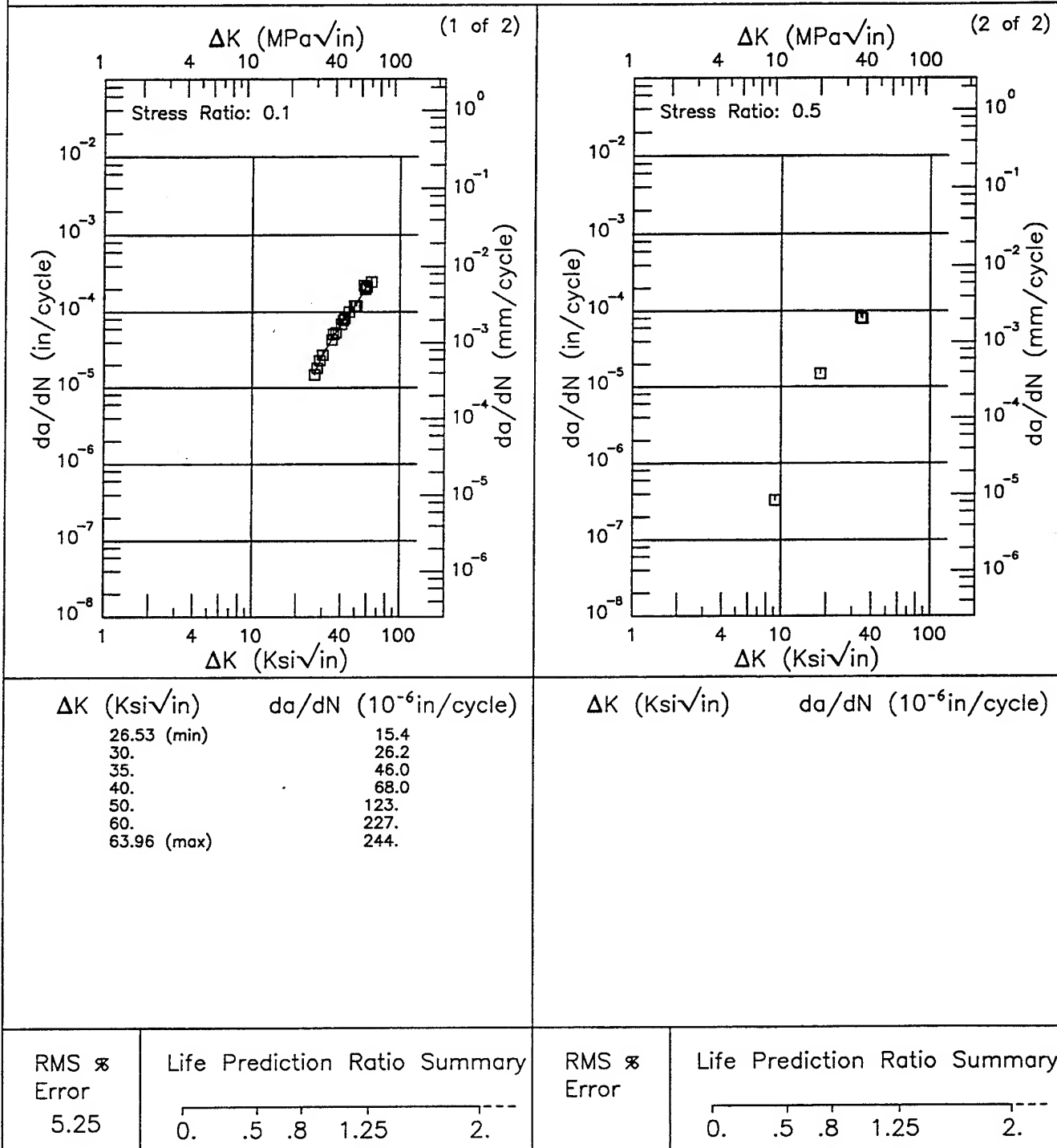
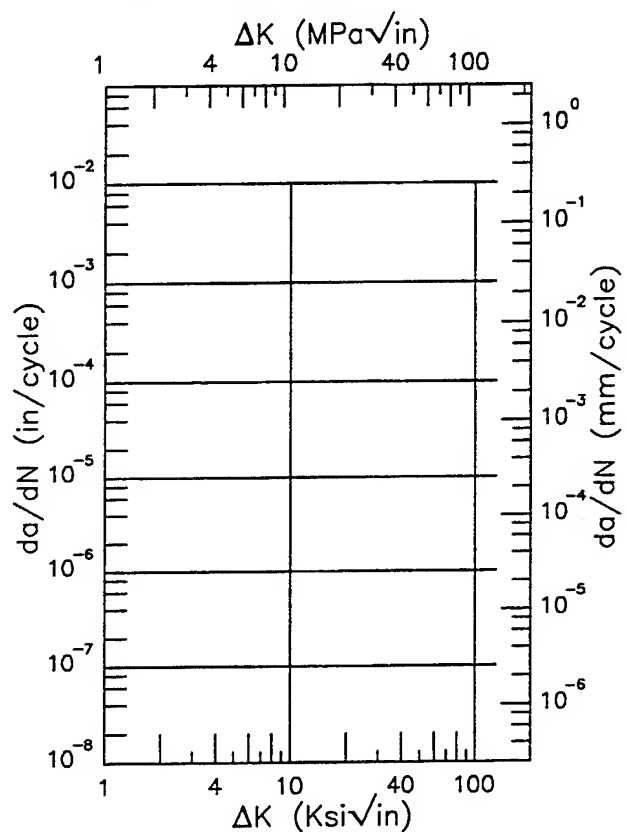
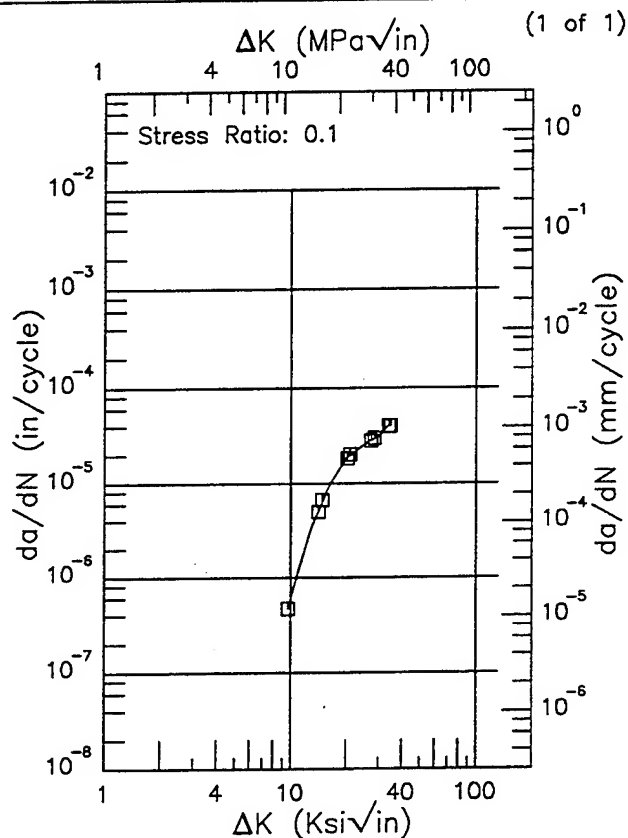


Figure 6.16.3.1.49

R | Ti-6Al-4V |

Condition/Ht: BA  
 Form: 0.63 in. Plate  
 Specimen Type: PTSF (max stress specified)  
 Orientation: T-S  
 Frequency: 10 Hz  
 Environment: 3.5% NACL; RT

Yield Strength: 124.5 ksi  
 Ult. Strength: 136.4 ksi  
 Specimen Thk: 0.672 in.  
 Specimen Width: 1.5 in.  
 Ref: 90981



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
9.65 (min)	0.468
10.	0.619
13.	3.48
16.	9.24
20.	18.4
25.	26.0
30.	31.8
34.71 (max)	42.3

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS %  
 Error  
 3.51

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

RMS %  
 Error

Life Prediction Ratio Summary

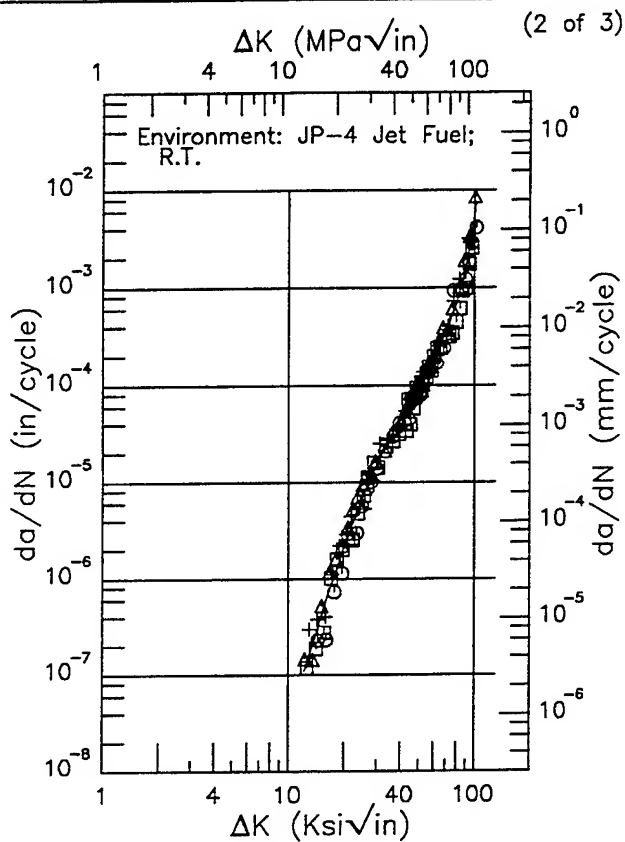
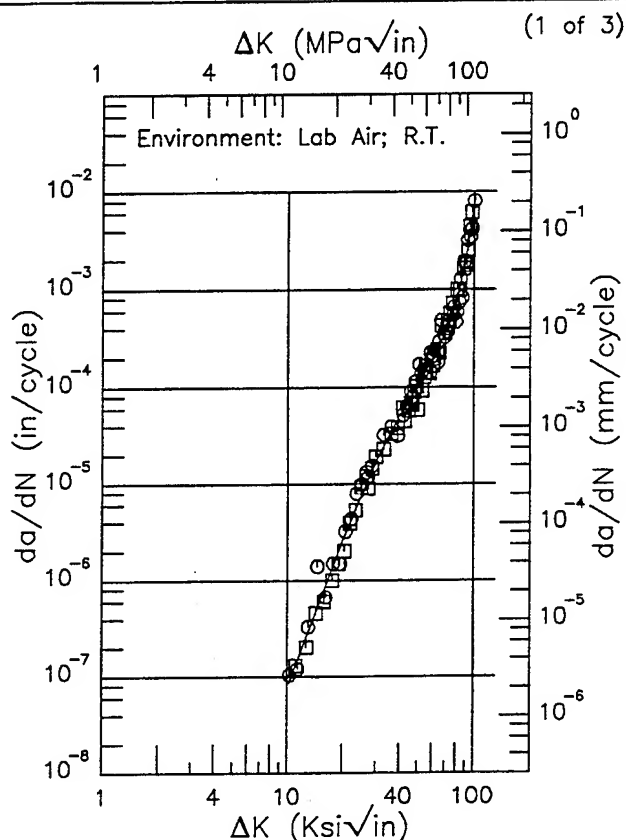
0. .5 .8 1.25 2. ---

Figure 6.16.3.1.50

**This page intentionally left blank**

E | Ti-6Al-4V |  
 Condition/Ht: BA  
 Form: 1.3 in. Forging  
 Specimen Type: WOL  
 Orientation: L-T  
 Stress Ratio: 0.02  
 Frequency: 0.1 - 20 Hz

Yield Strength: 111 - 111.5 ksi  
 Ult. Strength: 122.5 - 127.5 ksi  
 Specimen Thk: 1.25 in.  
 Specimen Width: 5 in.  
 Ref: MA005



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
10.25 (min)	0.0857
13.	0.285
16.	0.828
20.	2.55
25.	7.46
30.	16.8
35.	31.4
40.	51.2
50.	105.
60.	193.
70.	356.
80.	724.
90.	1946.
99.83 (max)	7407.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.23 (min)	0.109
13.	0.161
16.	0.581
20.	2.11
25.	6.74
30.	15.5
35.	28.5
40.	44.9
50.	91.5
60.	175.
70.	341.
80.	680.
90.	1542.
100.	5517.
101.83 (max)	7448.

RMS %  
 Error  
 26.85

Life Prediction Ratio Summary

RMS %  
 Error  
 25.48

Life Prediction Ratio Summary

Figure 6.16.3.1.51

Condition/Ht: BA  
 Form: 1.3 in. Forging  
 Specimen Type: WOL  
 Orientation: L-T  
 Stress Ratio: 0.02  
 Frequency: 0.1 - 20 Hz

Yield Strength: 111 - 111.5 ksi  
 Ult. Strength: 122.5 - 127.5 ksi  
 Specimen Thk: 1.25 in.  
 Specimen Width: 5 in.  
 Ref: MA005

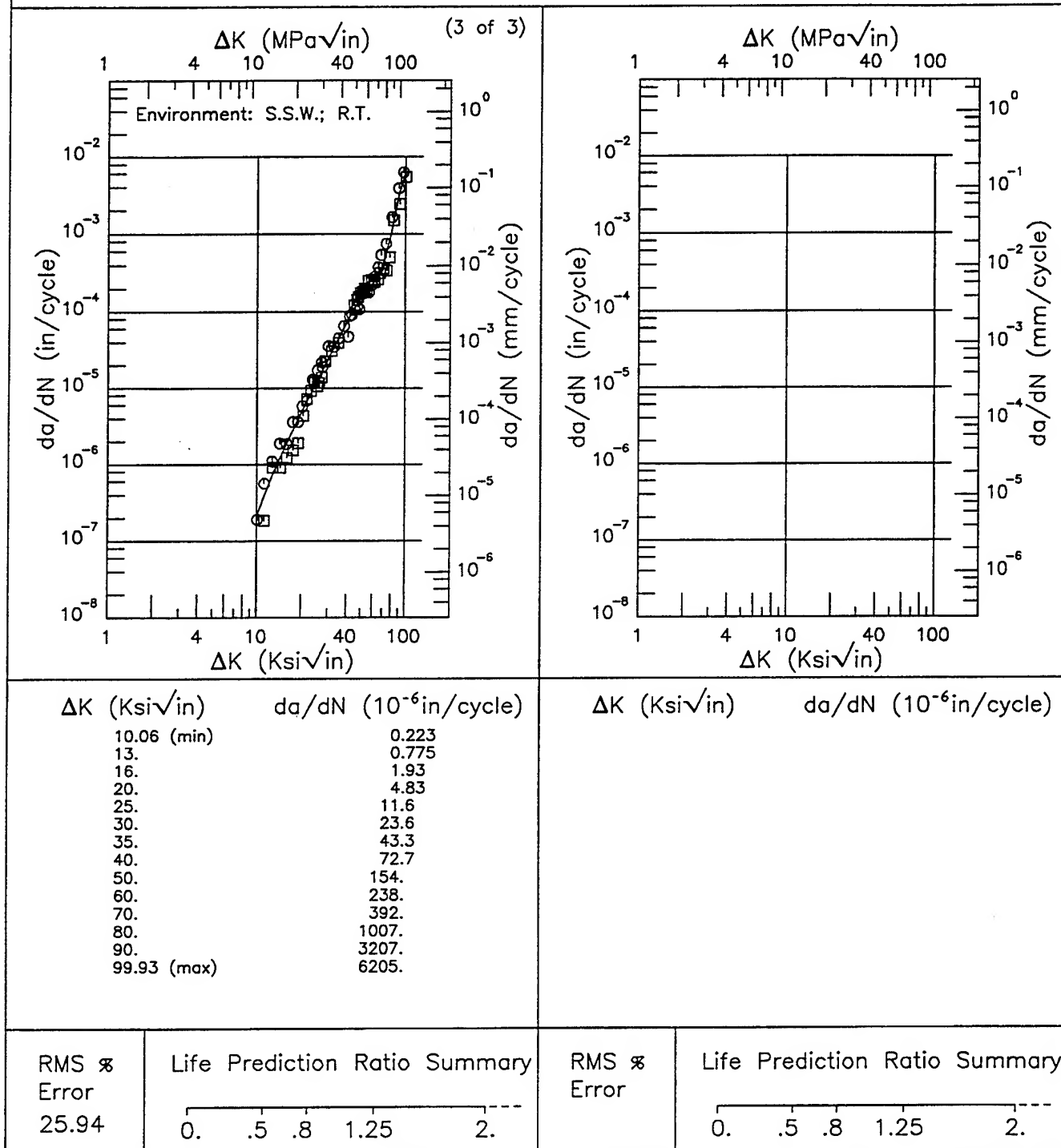


Figure 6.16.3.1.51 (Concluded)

E

Ti-6Al-4V

Condition/Ht: BA  
 Form: 1.3 in. Forging  
 Specimen Type: WOL  
 Orientation: T-L  
 Stress Ratio: 0.02  
 Frequency: 0.1 - 20 Hz

Yield Strength: 110 - 110.5 ksi  
 Ult. Strength: 124.5 - 125 ksi  
 Specimen Thk: 1.25 in.  
 Specimen Width: 5 in.  
 Ref: MA005

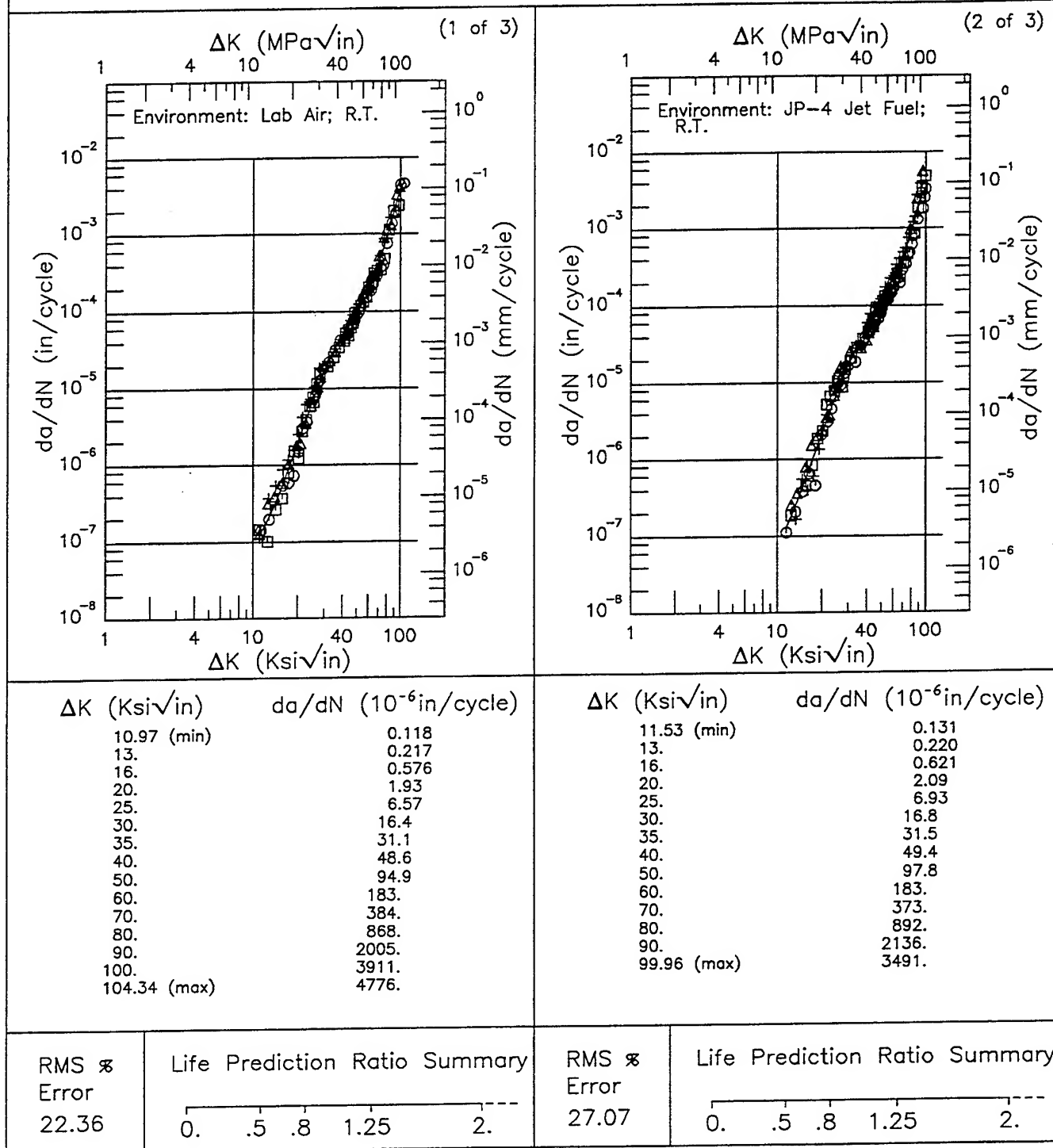


Figure 6.16.3.1.52

Condition/Ht: BA  
 Form: 1.3 in. Forging  
 Specimen Type: WOL  
 Orientation: T-L  
 Stress Ratio: 0.02  
 Frequency: 0.1 - 20 Hz

Yield Strength: 110 - 110.5 ksi  
 Ult. Strength: 124.5 - 125 ksi  
 Specimen Thk: 1.25 in.  
 Specimen Width: 5 in.  
 Ref: MA005

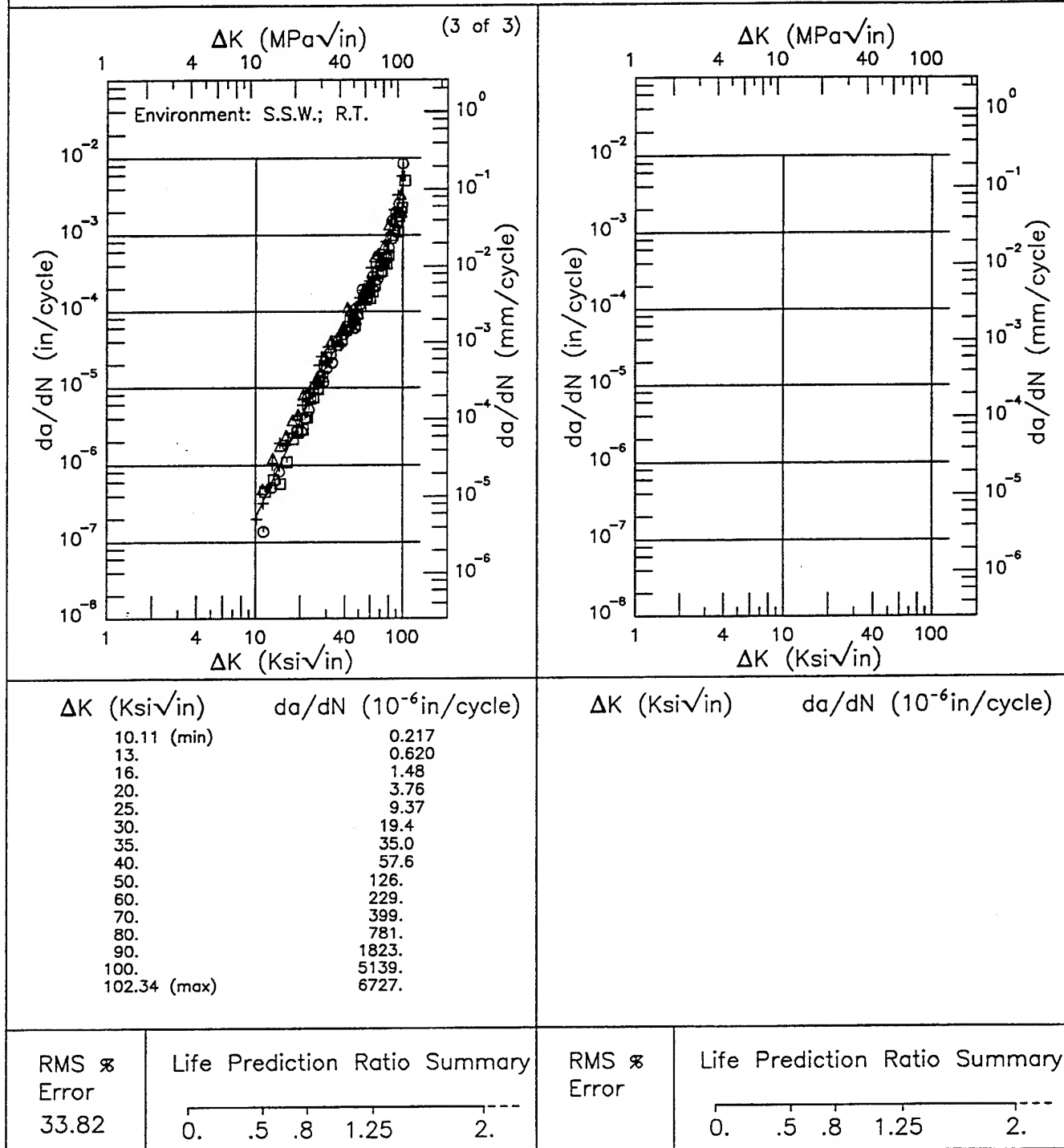


Figure 6.16.3.1.52 (Concluded)



R

Ti-6Al-4V

Condition/Ht: BETA PROCESSED - MA  
 Form: 0.13 in. Sheet  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 10 Hz  
 Environment: DRY AIR; RT

Yield Strength:  
 Ult. Strength:  
 Specimen Thk:  
 Specimen Width:  
 Ref: 91332

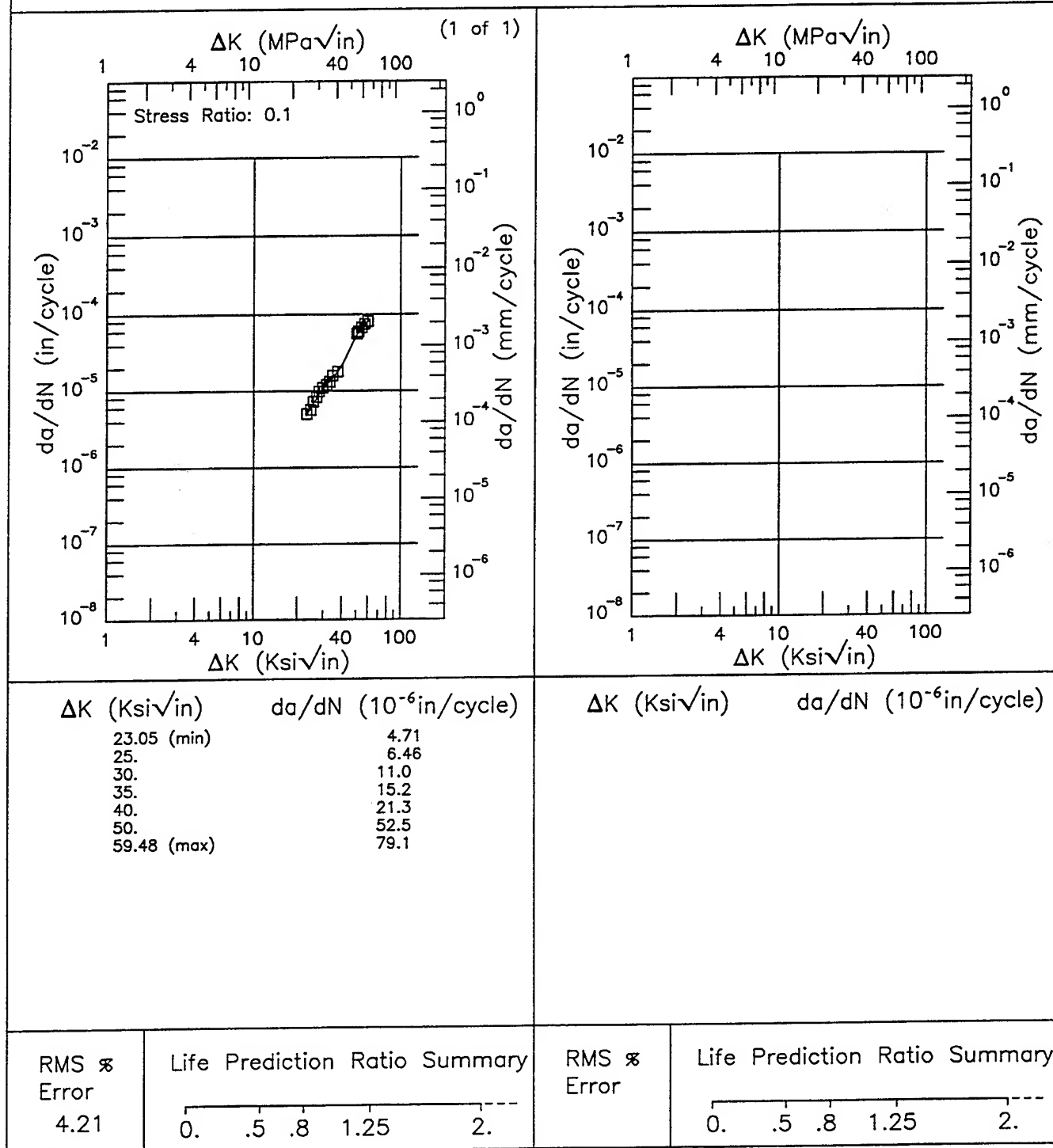


Figure 6.16.3.1.53

Condition/Ht: BETA PROCESSED - MA  
 Form: 0.3 - 0.5 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 10 Hz  
 Environment: DRY AIR; RT

Yield Strength:  
 Ult. Strength:  
 Specimen Thk:  
 Specimen Width:  
 Ref: 91332

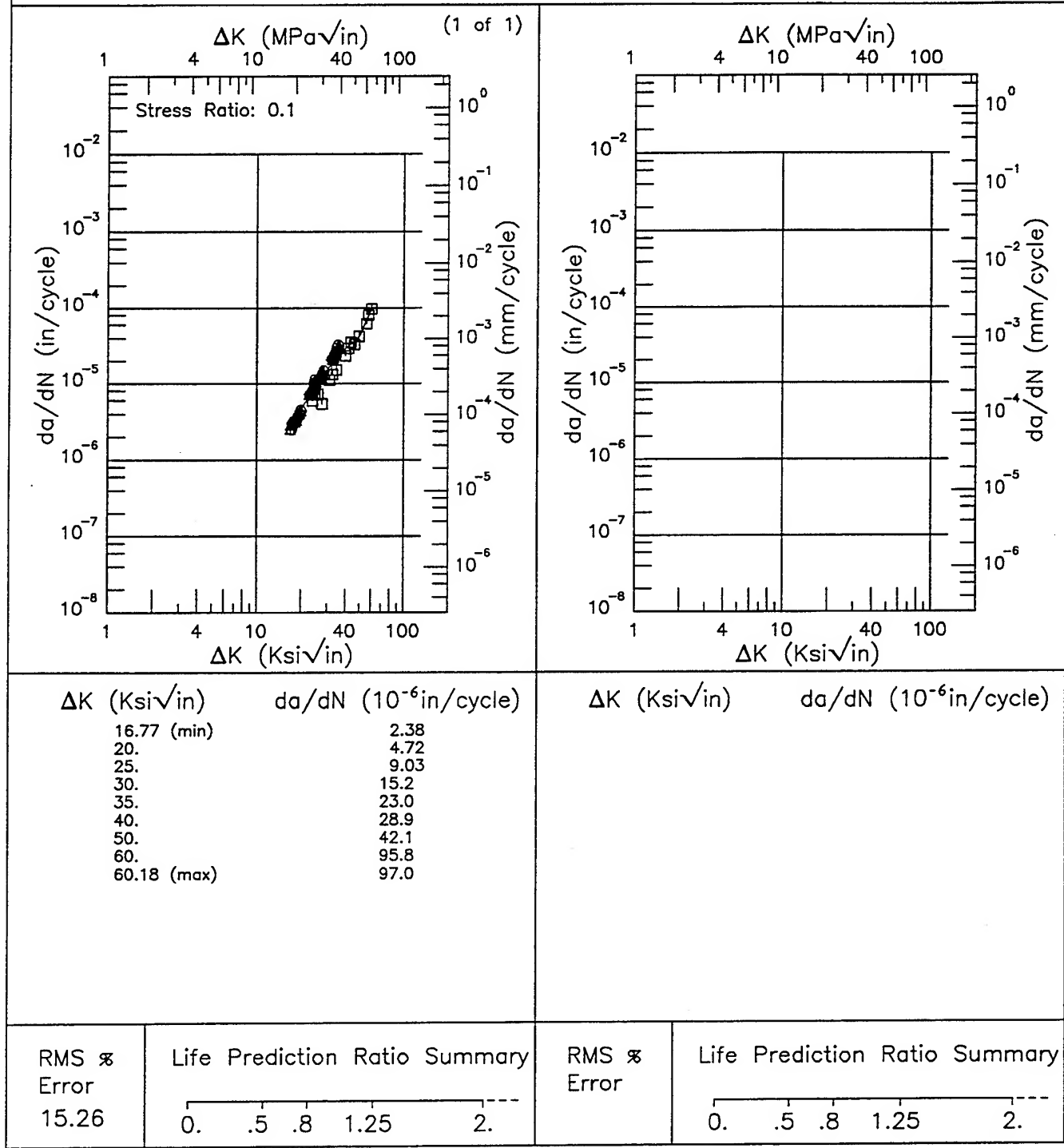
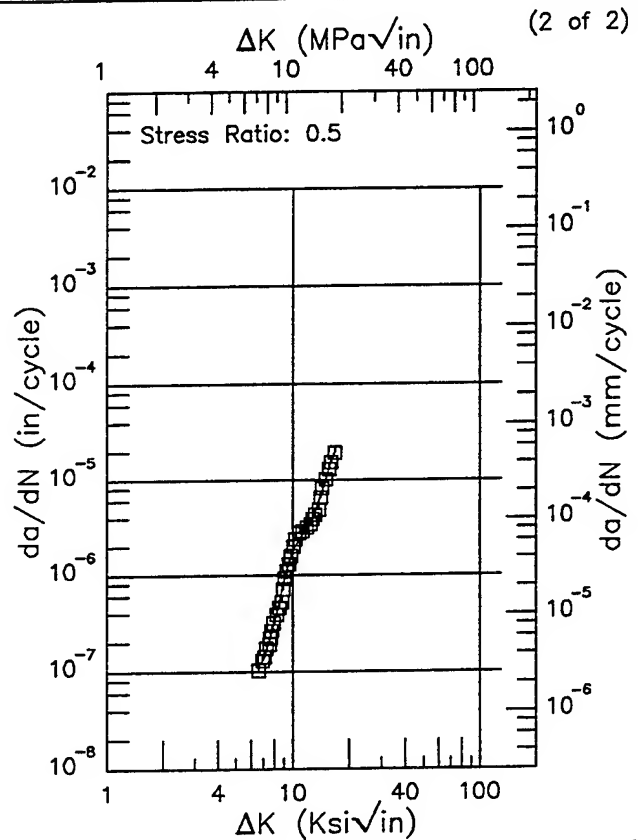
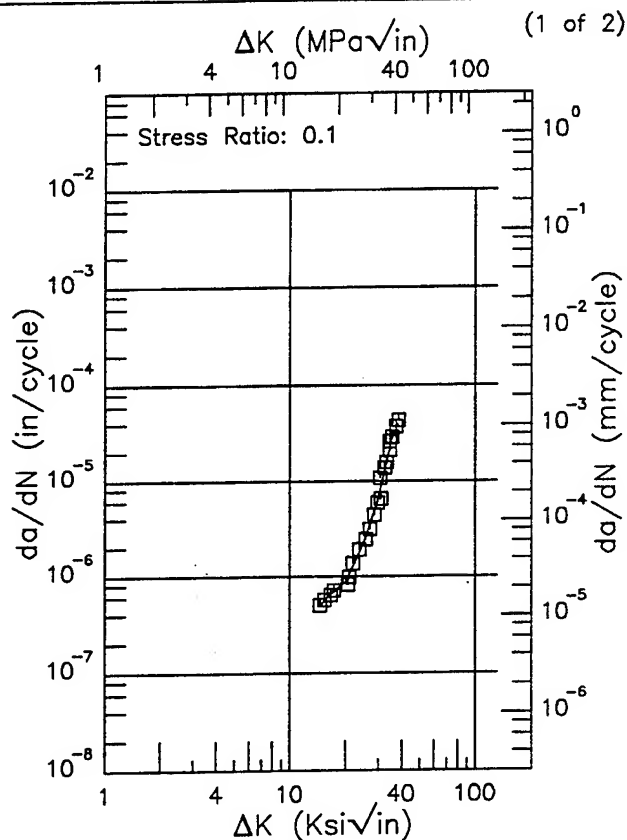


Figure 6.16.3.1.54

R | Ti-6Al-4V |

Condition/Ht: BETA PROCESSED - MA  
 Form: 3 in. Plate  
 Specimen Type: WOL  
 Orientation: L-T  
 Frequency: 1 Hz  
 Environment: LAB AIR; RT

Yield Strength: 130.4 ksi  
 Ult. Strength: 138.1 ksi  
 Specimen Thk: 1 in.  
 Specimen Width: 2.55 in.  
 Ref: UD008



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
14.50 (min)	0.493
16.	0.611
20.	0.874
25.	2.24
30.	6.50
35.	27.0
38.26 (max)	40.0

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
6.57 (min)	0.114
7.	0.132
8.	0.316
9.	0.874
10.	1.84
13.	4.17
16.	15.2
16.76 (max)	19.5

RMS %  
 Error  
 12.51

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

RMS %  
 Error  
 8.73

Life Prediction Ratio Summary

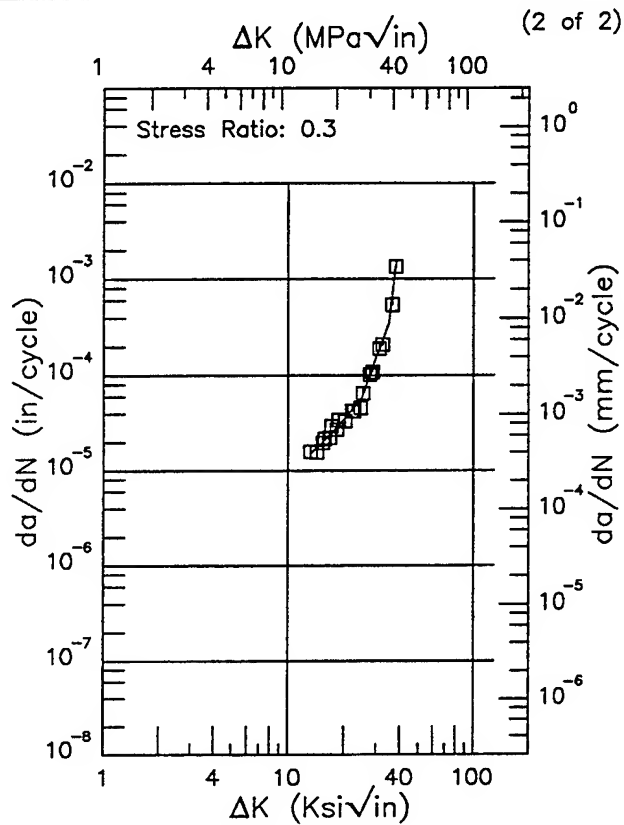
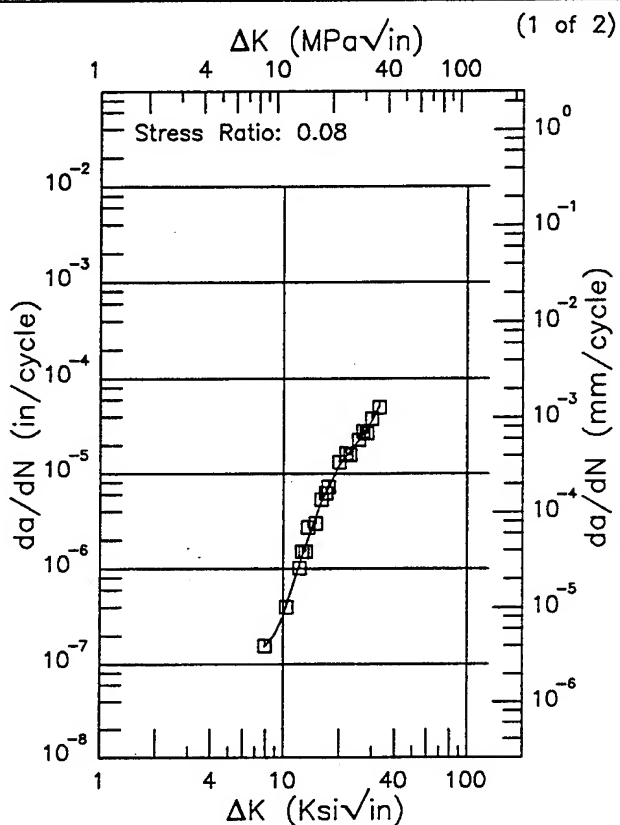
0. .5 .8 1.25 2. ---

Figure 6.16.3.1.55

Ti-6Al-4V R

Condition/Ht: DB  
Form: 0.63 - 1.5 in. Plate  
Specimen Type: CT  
Orientation: T-L  
Frequency: 6 Hz  
Environment: DRY AIR; RT

Yield Strength: 115 - 153 ksi  
Ult. Strength: 126 - 165 ksi  
Specimen Thk: 1 in.  
Specimen Width: 4.94 - 6 in.  
Ref: 88579



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
7.88 (min)	0.153
8.	0.156
9.	0.208
10.	0.331
13.	1.59
16.	5.14
20.	12.5
25.	21.5
30.	36.3
32.73 (max)	50.5

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
13.23 (min)	14.9
16.	21.1
20.	34.7
25.	57.3
30.	157.
35.	359.
37.82 (max)	1368.

RMS %  
Error  
10.63

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
Error  
8.89

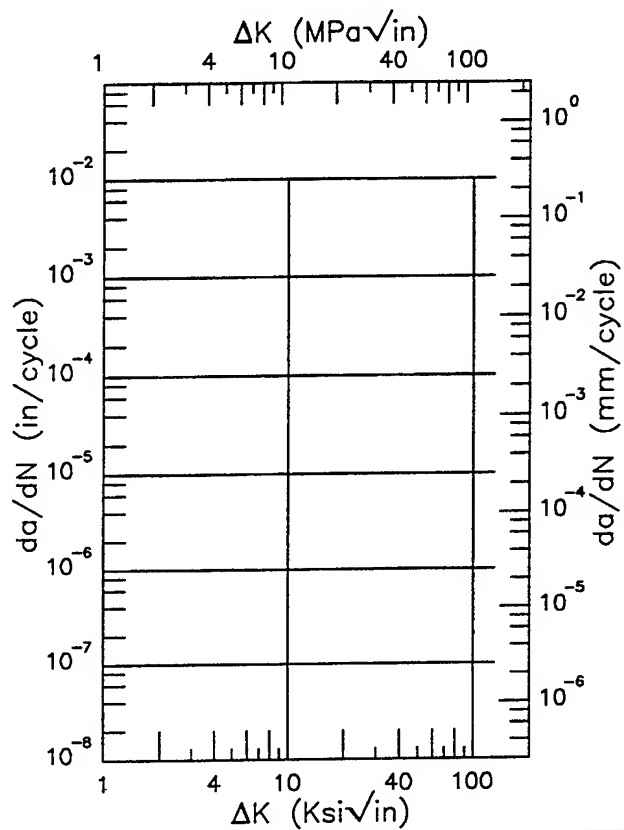
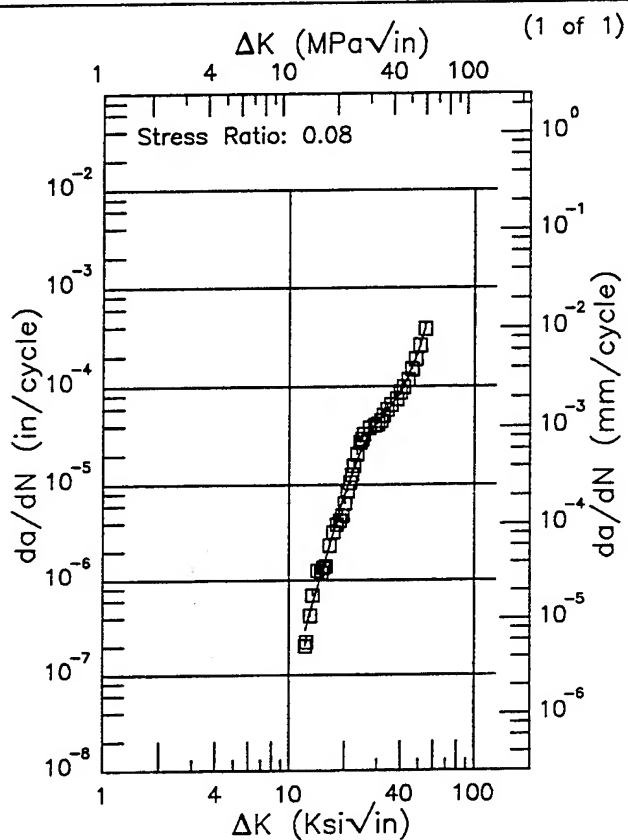
Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 6.16.3.1.56

R | Ti-6Al-4V |  
 Condition/Ht: DB  
 Form: 8 in. Plate  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 1 Hz  
 Environment: S.T.W.; RT

Yield Strength: 118 ksi  
 Ult. Strength: 128 ksi  
 Specimen Thk: 0.992 in.  
 Specimen Width: 6 in.  
 Ref: 85837



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
12.21 (min)	0.296
13.	0.442
16.	1.81
20.	7.90
25.	25.4
30.	44.8
35.	62.2
40.	86.3
50.	226.
54.03 (max)	380.

ΔK (Ksi√in)      da/dN (10<sup>-6</sup>in/cycle)

RMS %  
 Error  
 16.59

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2. ---

RMS %  
 Error

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2. ---

Figure 6.16.3.1.57

Condition/Ht: DB  
 Form: 8 in. Plate  
 Specimen Type: CT  
 Orientation: S-T  
 Frequency: 1 Hz  
 Environment: S.T.W.; RT

Yield Strength: 114 ksi  
 Ult. Strength: 128 ksi  
 Specimen Thk: 0.993 in.  
 Specimen Width: 4.94 in.  
 Ref: 85837

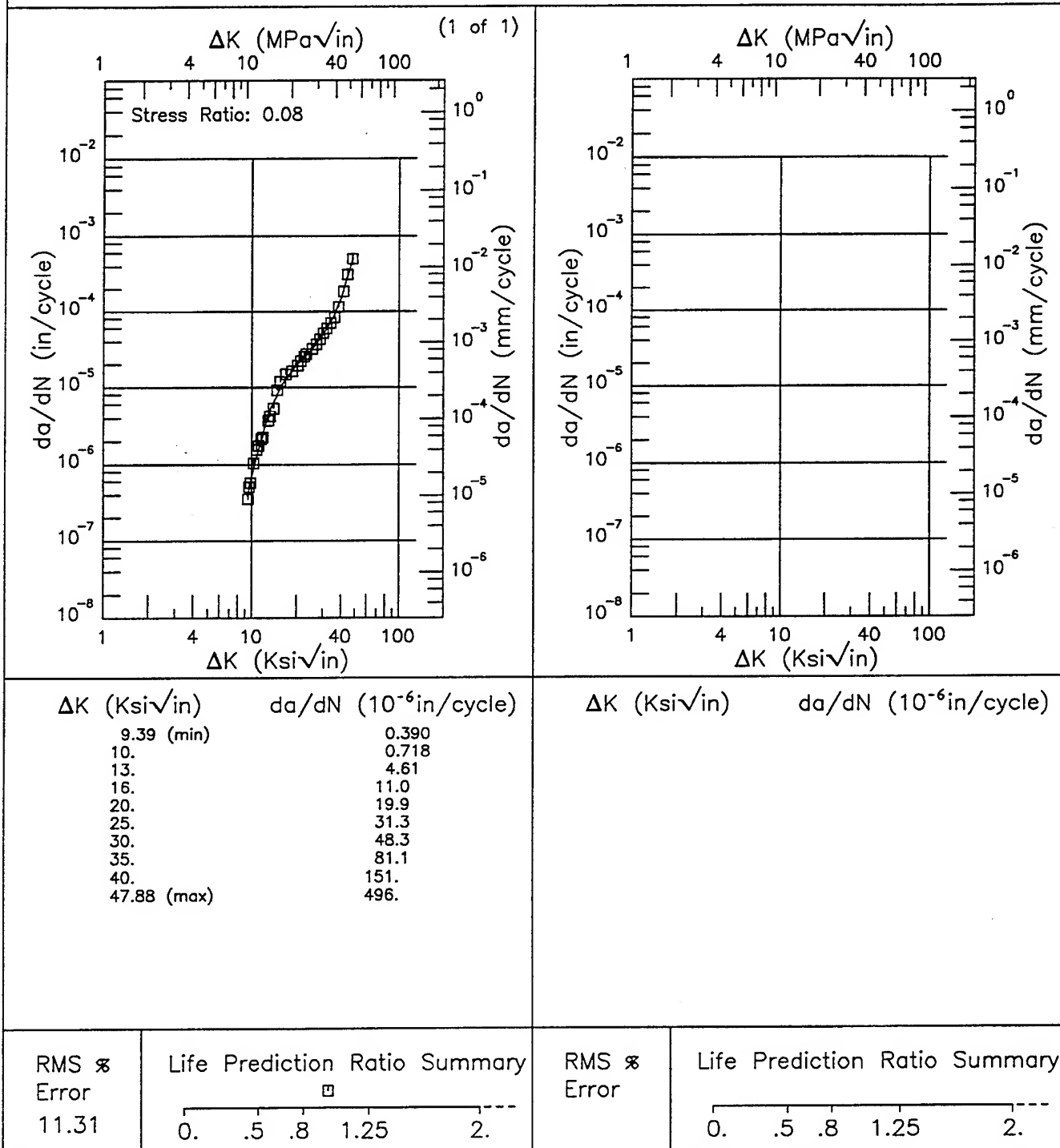


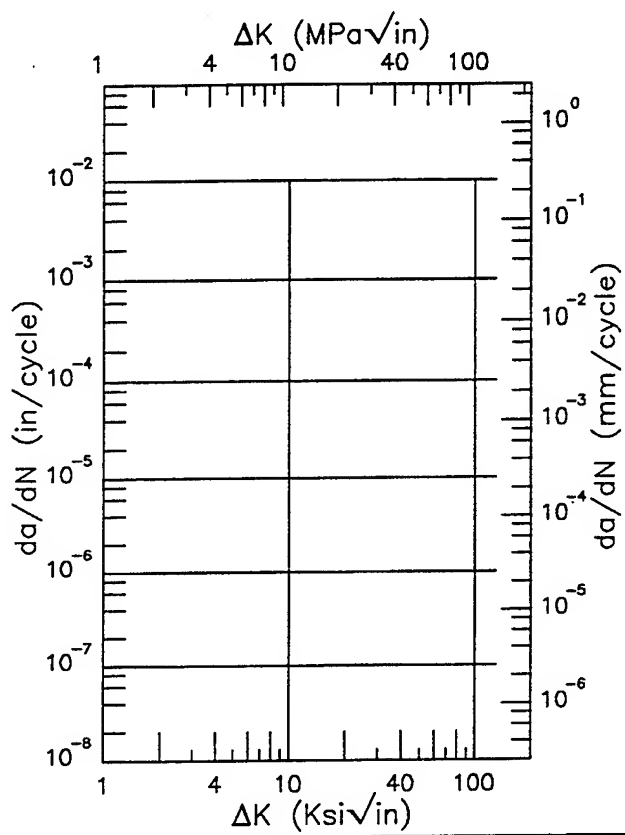
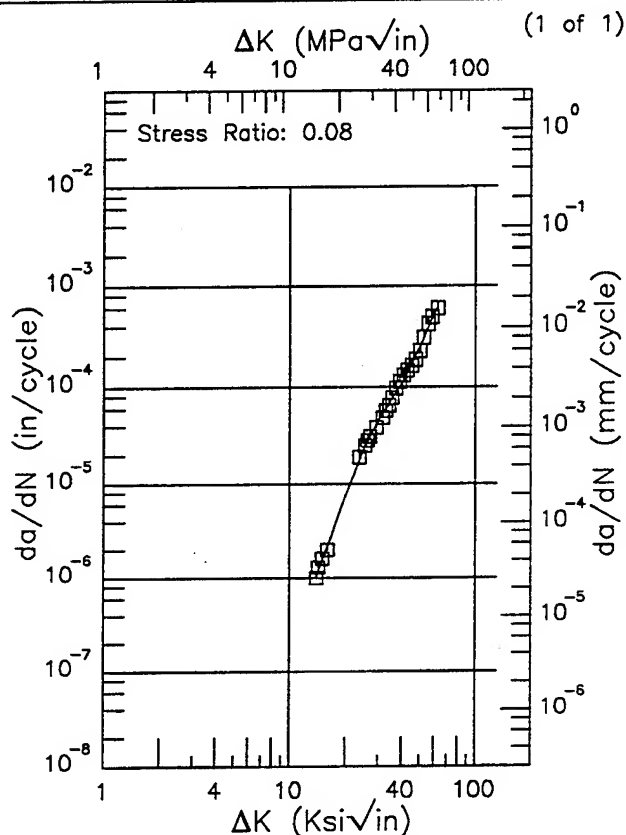
Figure 6.16.3.1.58

R

Ti-6Al-4V

Condition/Ht: DB + 2DBTC  
 Form: 8 in. Plate  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 1 Hz  
 Environment: S.T.W.; RT

Yield Strength: 114 ksi  
 Ult. Strength: 128 ksi  
 Specimen Thk: 0.996 in.  
 Specimen Width: 6 in.  
 Ref: 85837



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
13.92 (min)	1.02
16.	2.18
20.	7.62
25.	23.1
30.	45.9
35.	73.5
40.	110.
50.	249.
60.	536.
62.46 (max)	601.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
--------------------------------------	-------------------------------

RMS  $\times$   
 Error  
 6.60

Life Prediction Ratio Summary  
  
 0. .5 .8 1.25 2.

RMS  $\times$   
 Error

Life Prediction Ratio Summary  
  
 0. .5 .8 1.25 2.

Figure 6.16.3.1.59

Condition/Ht: DB + 2DBTC  
 Form: 8 in. Plate  
 Specimen Type: CT  
 Orientation: S-T  
 Frequency: 6 Hz  
 Environment: DRY AIR; RT

Yield Strength: 114 ksi  
 Ult. Strength: 128 ksi  
 Specimen Thk: 0.983 in.  
 Specimen Width: 4.95 in.  
 Ref: 85837

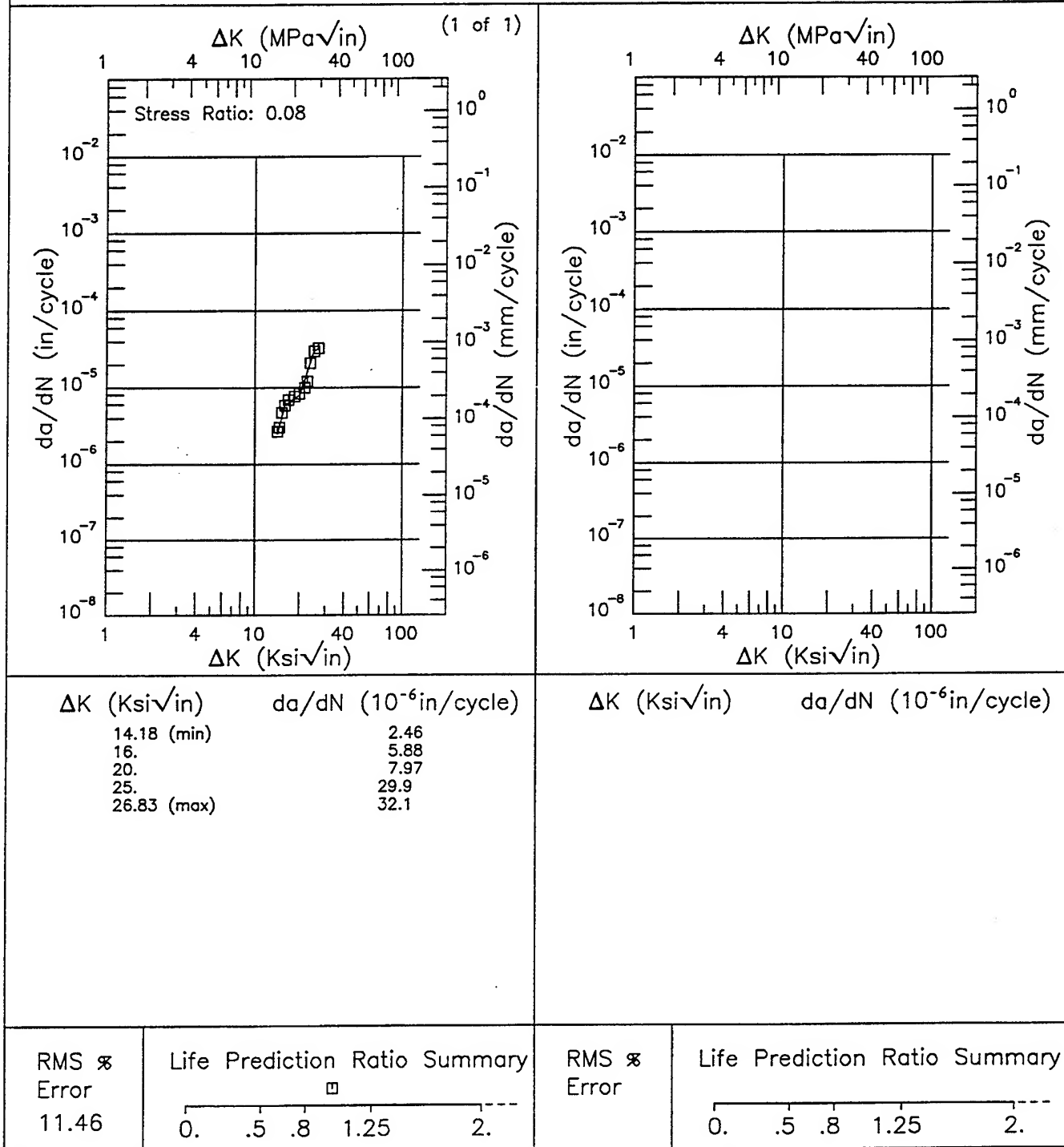


Figure 6.16.3.1.60

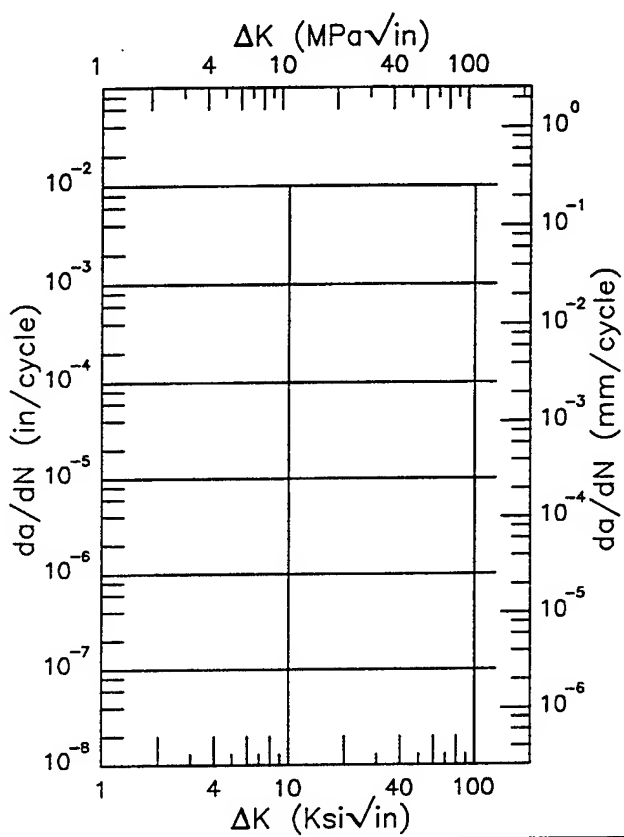
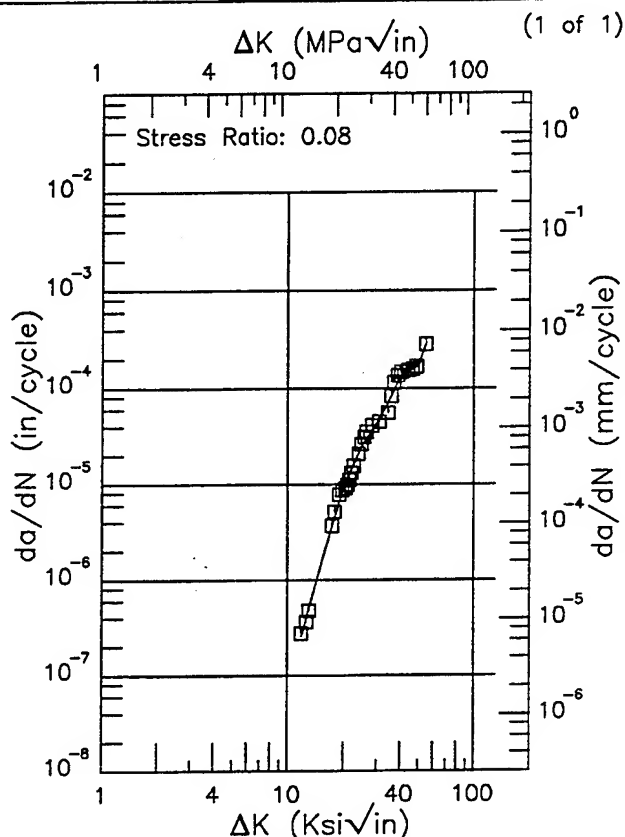


R

Ti-6Al-4V

Condition/Ht: DB + 4DBTC  
 Form: 8 in. Plate  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 1 Hz  
 Environment: S.T.W.; RT

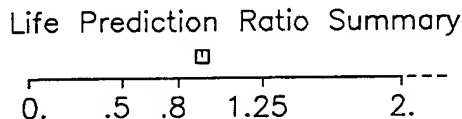
Yield Strength: 115 ksi  
 Ult. Strength: 126 ksi  
 Specimen Thk: 0.99 in.  
 Specimen Width: 6 in.  
 Ref: 85837



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
11.85 (min)	0.255
13.	0.475
16.	2.15
20.	9.51
25.	25.4
30.	42.9
35.	76.1
40.	132.
50.	171.
54.46 (max)	281.

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
-------------	-----------------------------------

RMS %  
 Error  
 11.49



RMS %  
 Error

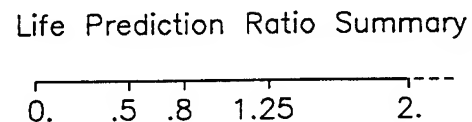


Figure 6.16.3.1.61

Ti-6Al-4V R

Condition/Ht: DB + TR  
Form: 1.5 in. Plate  
Specimen Type: CT  
Orientation: S-T  
Frequency: 1 Hz  
Environment: S.T.W.; RT

Yield Strength: 111 ksi  
Ult. Strength: 128 ksi  
Specimen Thk: 1 in.  
Specimen Width: 5 in.  
Ref: 88579

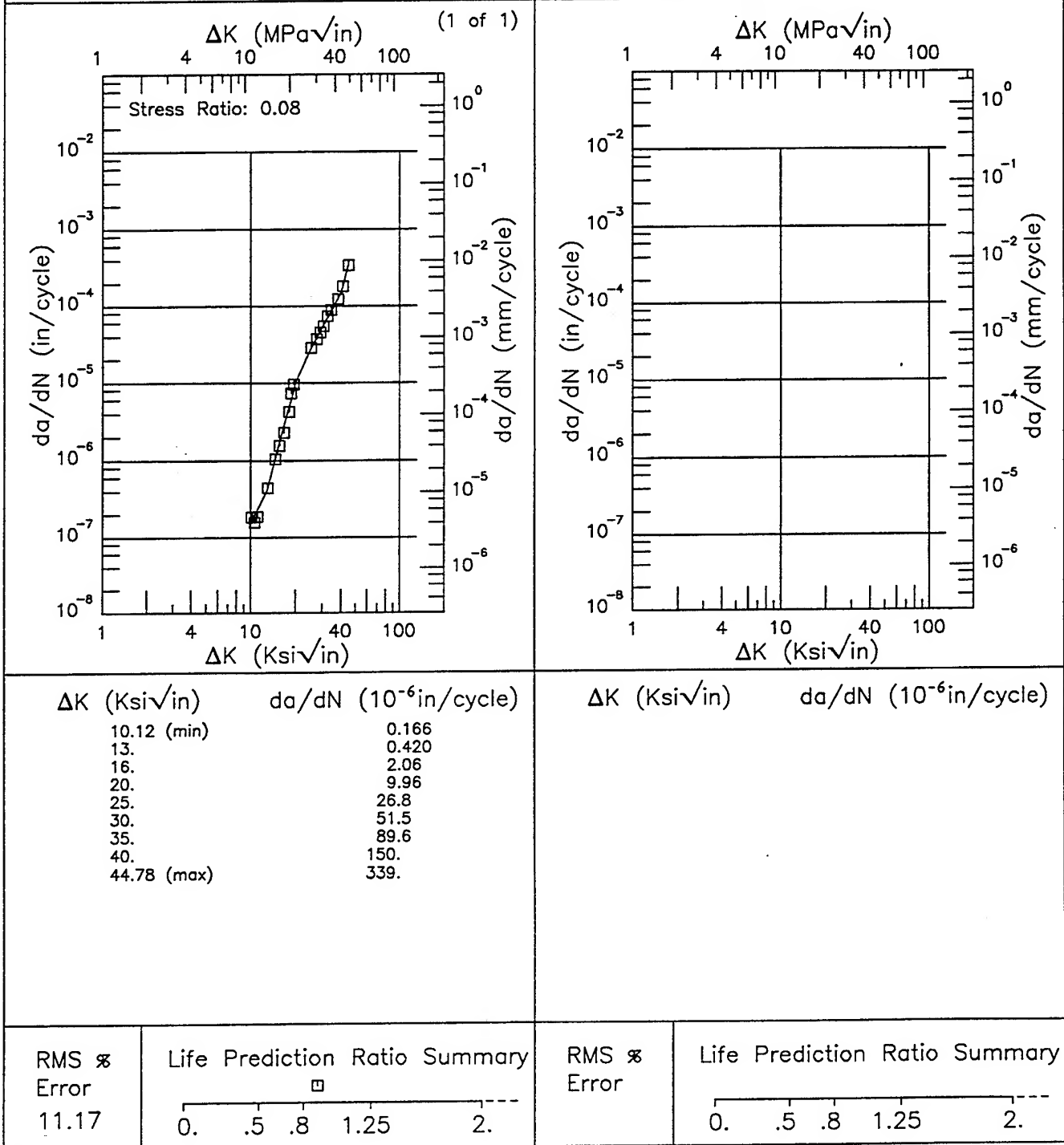
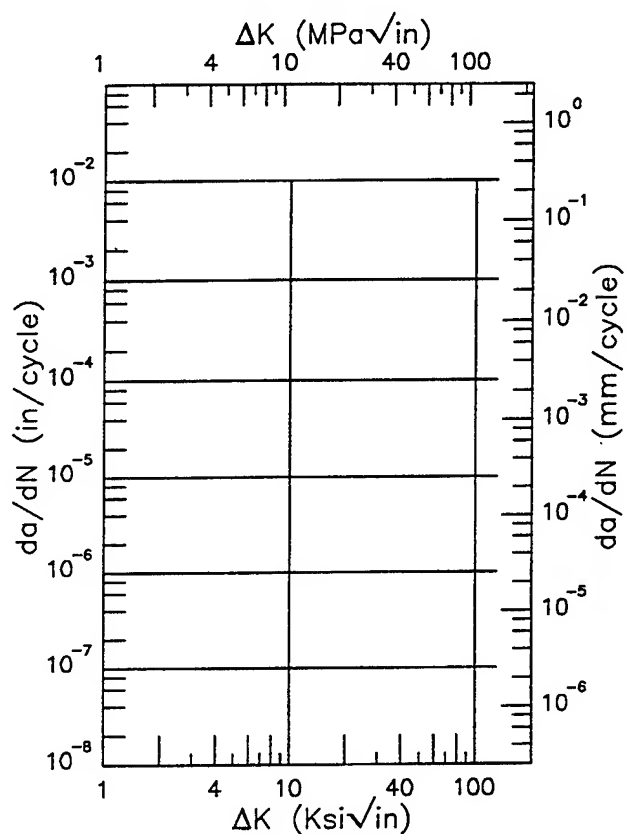
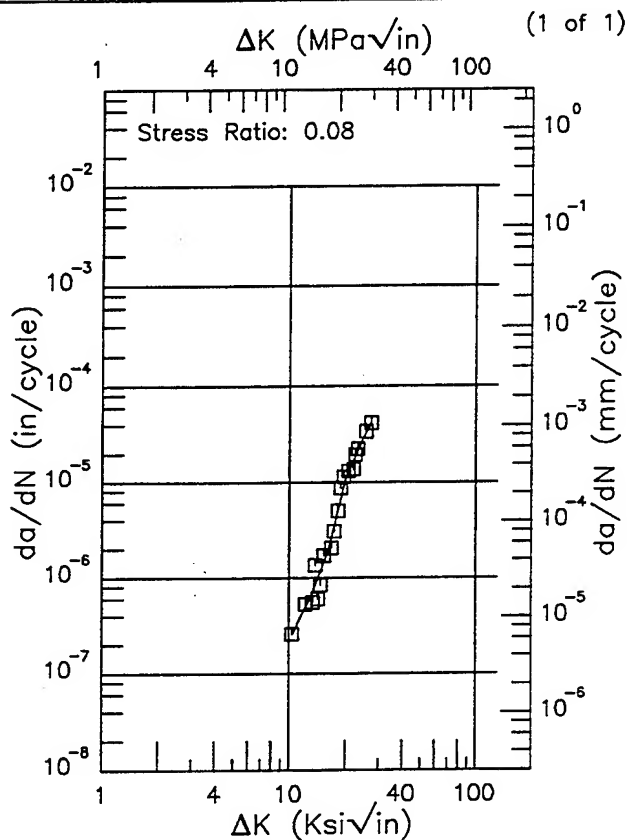


Figure 6.16.3.1.62

R | Ti-6Al-4V |  
 Condition/Ht: DBT + PC  
 Form: 2.5 in. Plate  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 1 Hz  
 Environment: S.T.W.; RT

Yield Strength: 122 ksi  
 Ult. Strength: 135 ksi  
 Specimen Thk: 0.35 in.  
 Specimen Width: 7.4 in.  
 Ref: 88579



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
10.37 (min)	0.256
13.	0.623
16.	1.87
20.	11.1
25.	30.7
27.18 (max)	41.6

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS  $\%$   
 Error  
 23.75

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

RMS  $\%$   
 Error

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

Figure 6.16.3.1.63

Ti-6Al-4V R

Condition/Ht: DBTC  
Form: 0.62 - 0.63 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Frequency: 1 Hz  
Environment: DRY AIR; RT

Yield Strength: 138 - 140 ksi  
Ult. Strength: 148 - 150 ksi  
Specimen Thk: 0.496 - 0.5 in.  
Specimen Width: 6 in.  
Ref: 88579;85837

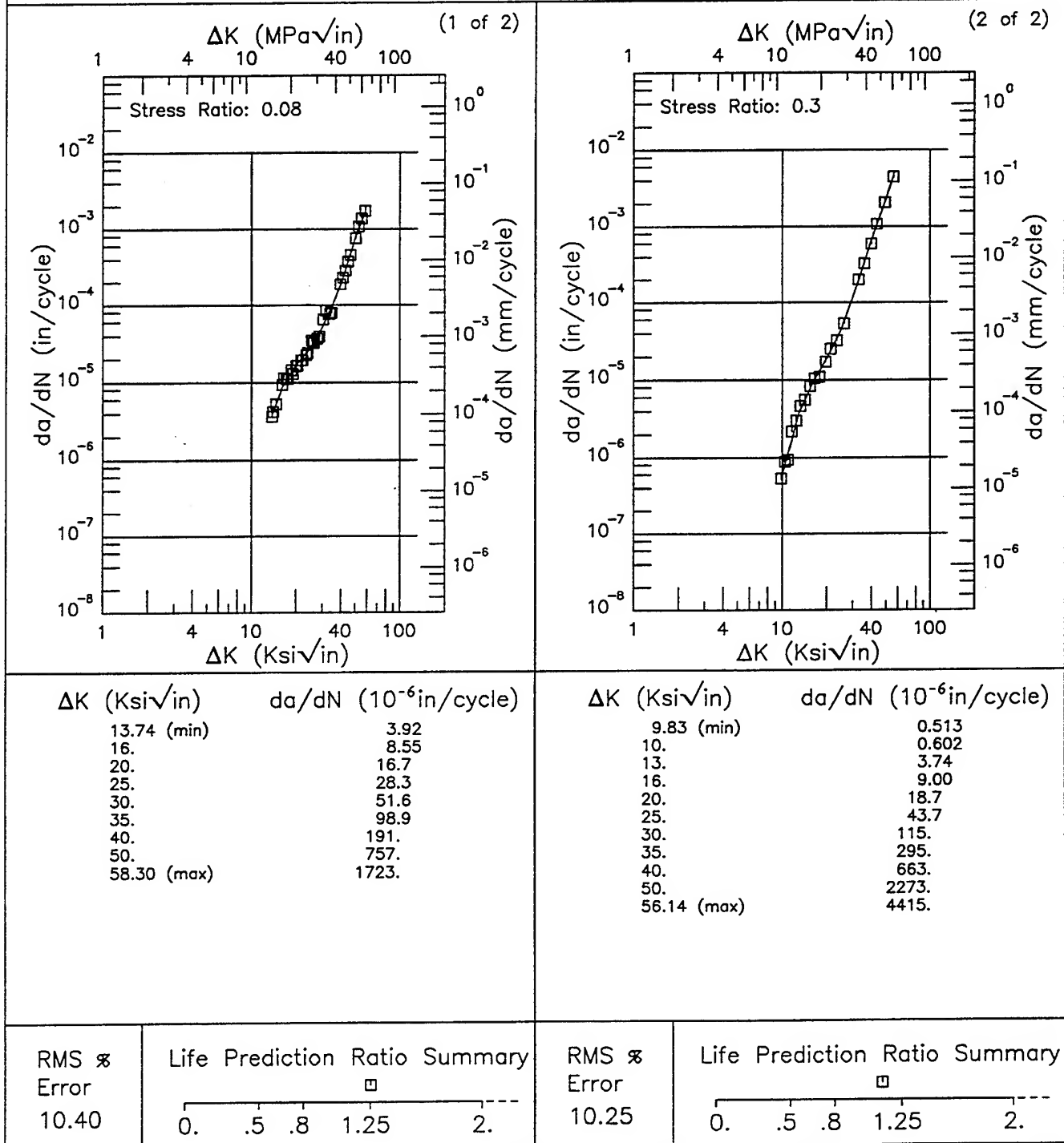
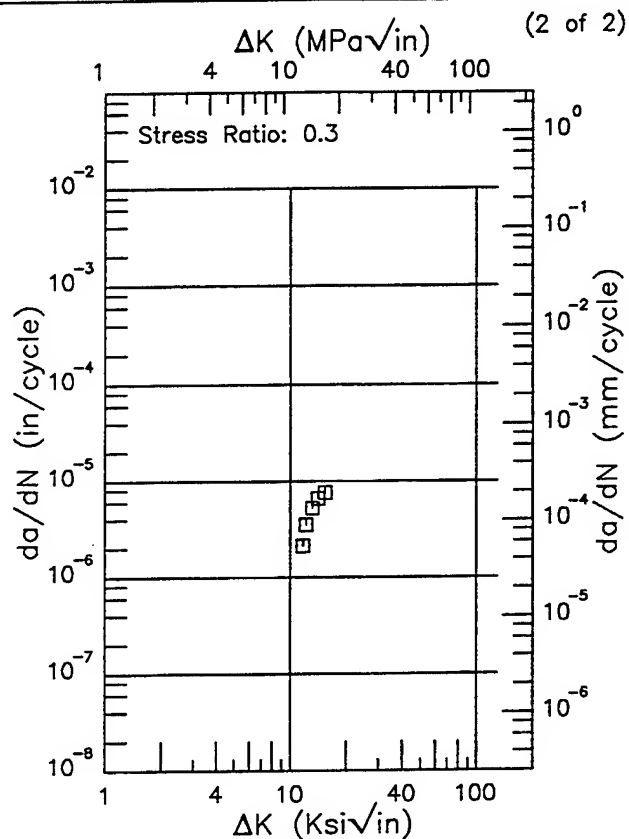
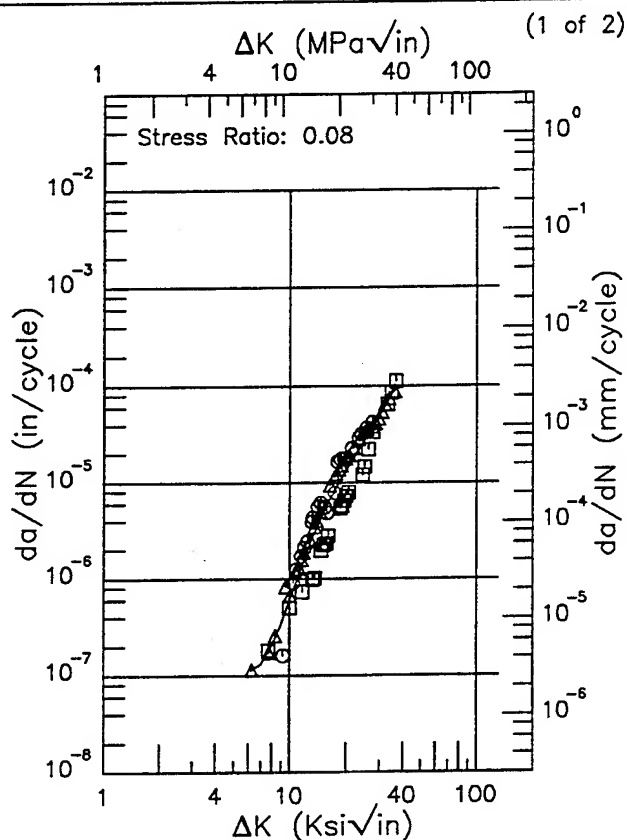


Figure 6.16.3.1.64

R | Ti-6Al-4V |  
 Condition/Ht: DBTC  
 Form: 1.25 - 1.5 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 1 Hz  
 Environment: S.T.W.; RT

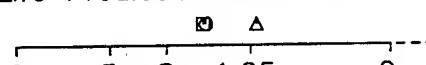
Yield Strength: 117 - 125 ksi  
 Ult. Strength: 129 - 138 ksi  
 Specimen Thk: 0.99 - 1 in.  
 Specimen Width: 6 - 7.4 in.  
 Ref: 88579;85837



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
6.24 (min)	0.112
7.	0.131
8.	0.201
9.	0.341
10.	0.592
13.	2.49
16.	6.28
20.	13.5
25.	27.4
30.	49.2
35.	83.9
36.57 (max)	99.2

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS %  
 Error  
 37.08

Life Prediction Ratio Summary  


RMS %  
 Error

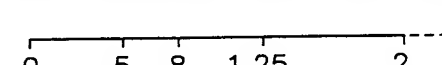
Life Prediction Ratio Summary  


Figure 6.16.3.1.65

Condition/Ht: DBTC  
Form: 1.25 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Frequency: 1 Hz  
Environment: DRY AIR; RT

Yield Strength: 125 ksi  
Ult. Strength: 137 ksi  
Specimen Thk: 1 in.  
Specimen Width: 6 in.  
Ref: 88579

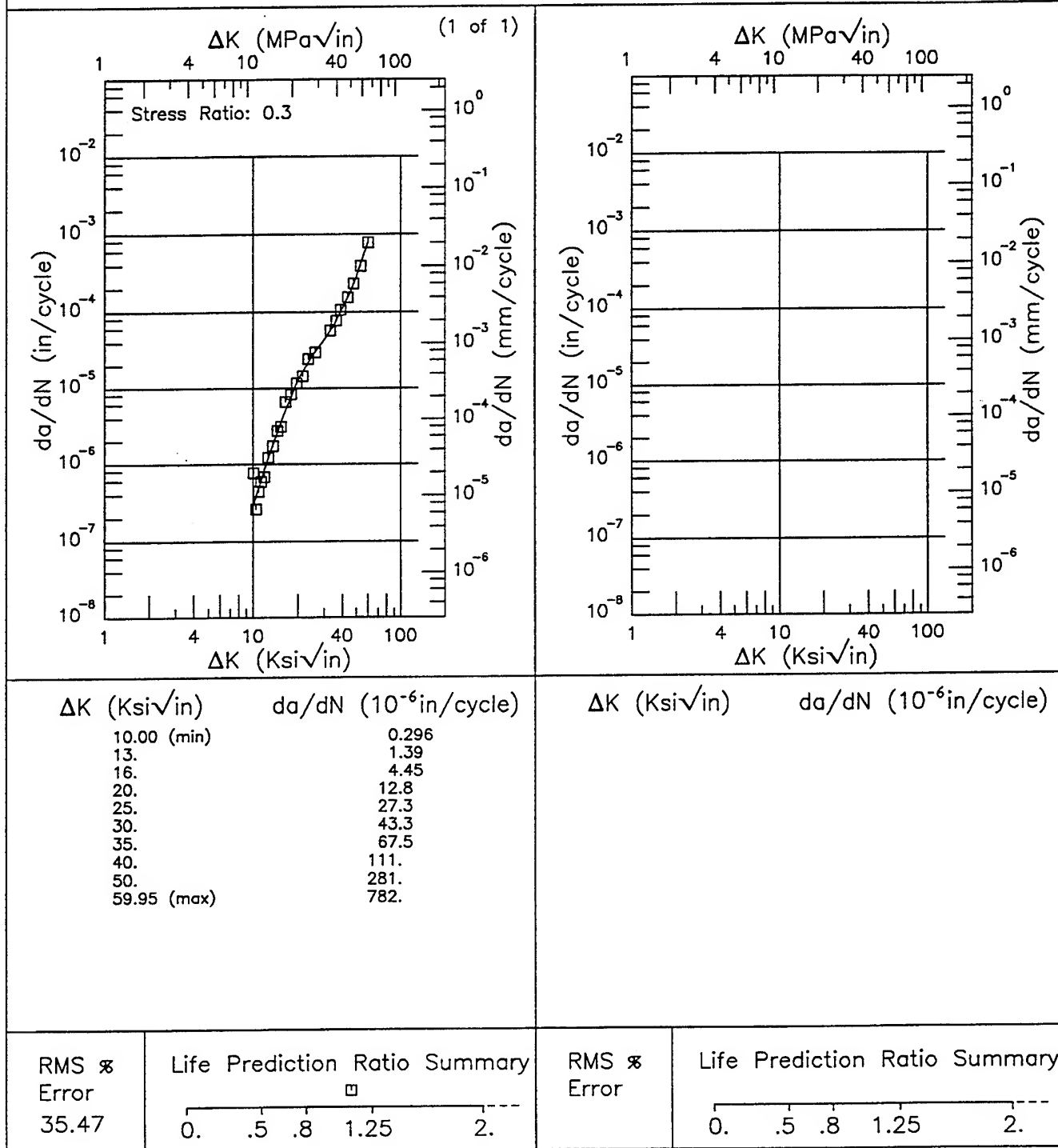


Figure 6.16.3.1.66

R

Ti-6Al-4V

Condition/Ht: DBTC

Form: 1.25 - 1.5 in. Plate

Specimen Type: CT

Orientation: T-L

Frequency: 1 Hz

Environment: DRY AIR; RT

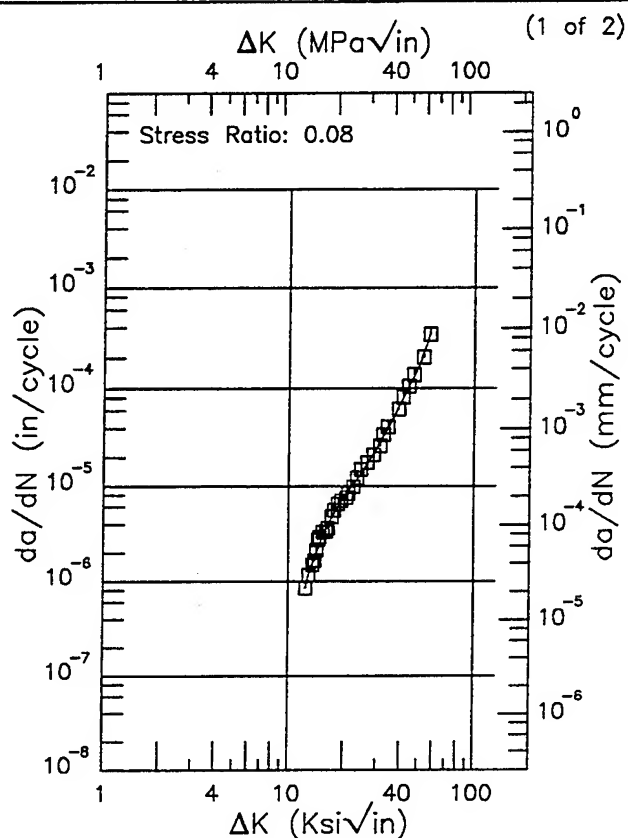
Yield Strength: 119 - 128 ksi

Ult. Strength: 134 - 139 ksi

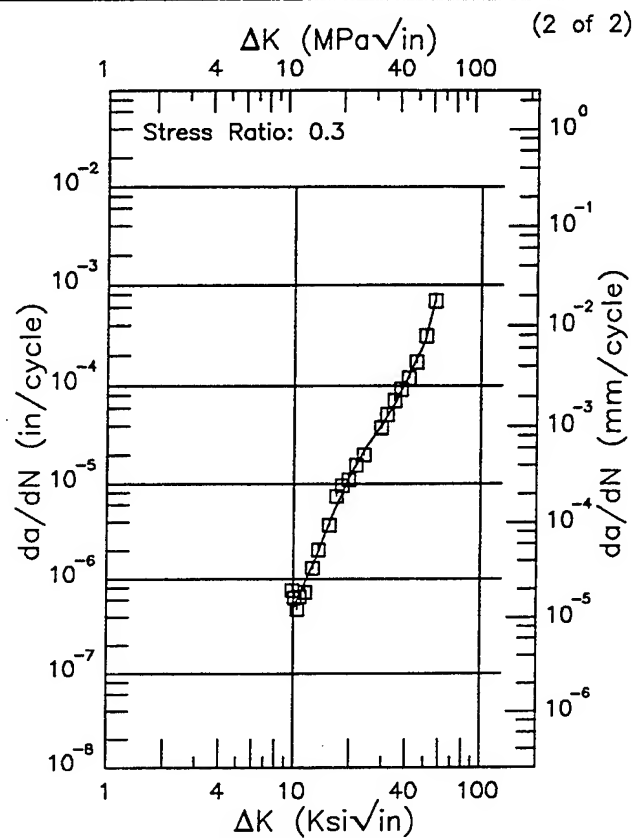
Specimen Thk: 0.96 - 1 in.

Specimen Width: 6 - 7.46 in.

Ref: 88579



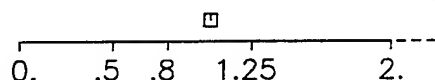
$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.36 (min)	0.842
13.	1.22
16.	3.71
20.	7.71
25.	14.1
30.	25.2
35.	43.4
40.	71.4
50.	162.
57.13 (max)	334.



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
9.82 (min)	0.458
10.	0.489
13.	1.56
16.	4.42
20.	12.3
25.	25.7
30.	41.8
35.	68.0
40.	113.
50.	276.
56.48 (max)	694.

RMS %  
Error  
8.42

Life Prediction Ratio Summary



RMS %  
Error  
18.51

Life Prediction Ratio Summary

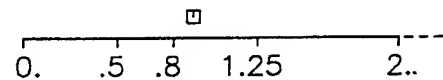


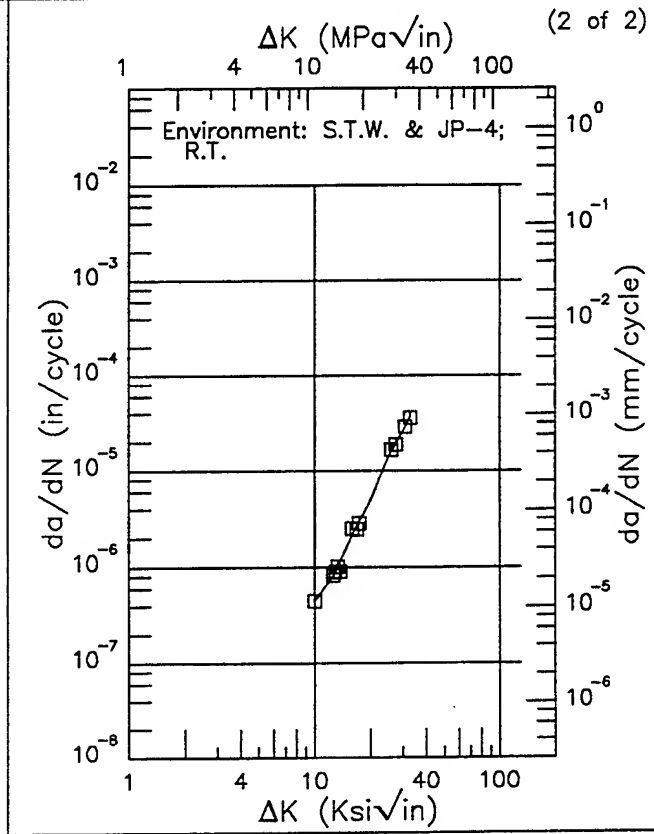
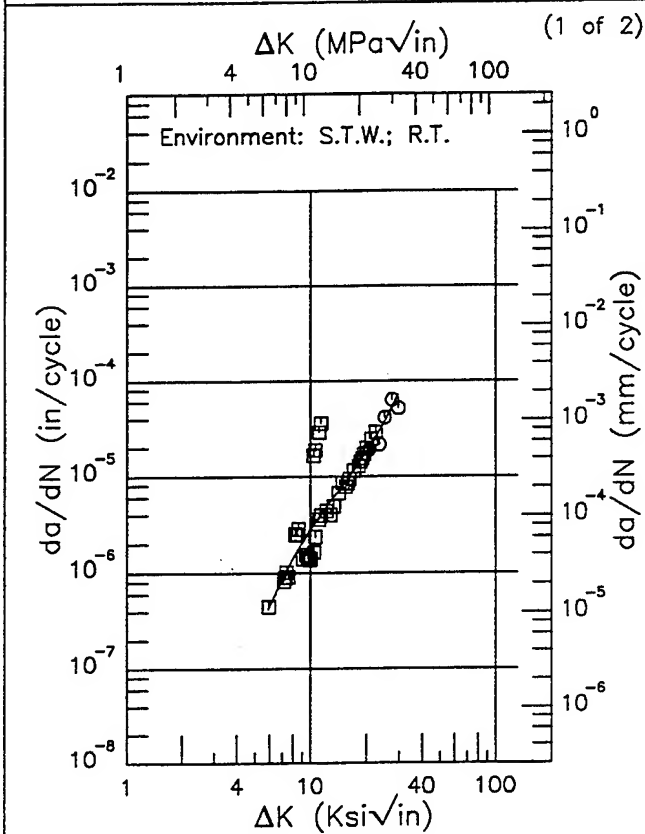
Figure 6.16.3.1.67

Ti-6Al-4V

E

Condition/Ht: DBTC  
Form: 1.5 - 2.5 in. Plate  
Specimen Type: CT  
Orientation: T-L  
Stress Ratio: 0.08  
Frequency: 1 Hz

Yield Strength: 119 - 125 ksi  
Ult. Strength: 132 - 135 ksi  
Specimen Thk: 0.962 - 1 in.  
Specimen Width: 4.94 - 7.4 in.  
Ref: 85837;88579



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
5.90 (min)	0.421
6.	0.455
7.	0.866
8.	1.41
9.	2.06
10.	2.81
13.	5.66
16.	9.65
20.	17.9
25.	36.8
29.65 (max)	71.3

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
9.95 (min)	0.449
10.	0.449
13.	0.891
16.	2.19
20.	4.92
25.	13.9
30.	25.9
32.61 (max)	35.8

RMS %  
Error  
>100.0

Life Prediction Ratio Summary  
□ ○  
0. .5 .8 1.25 2.

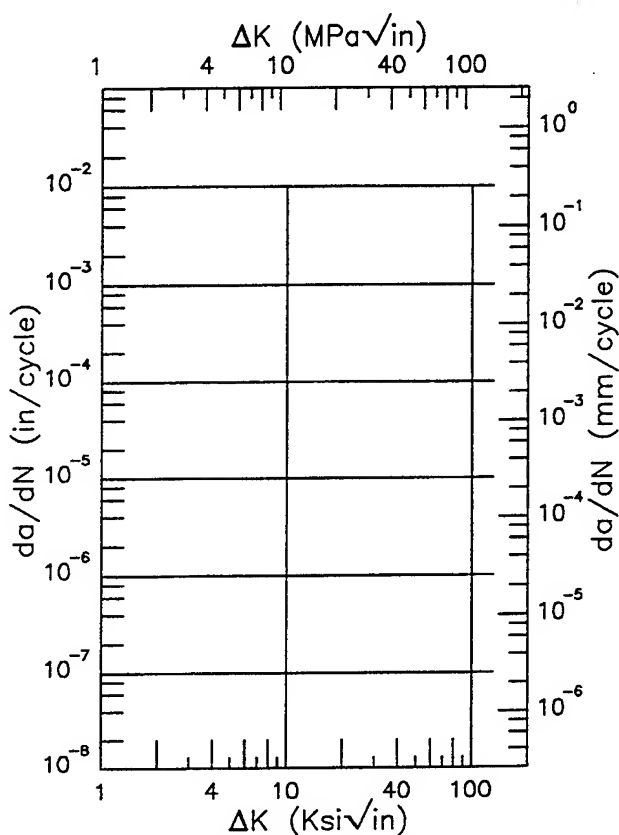
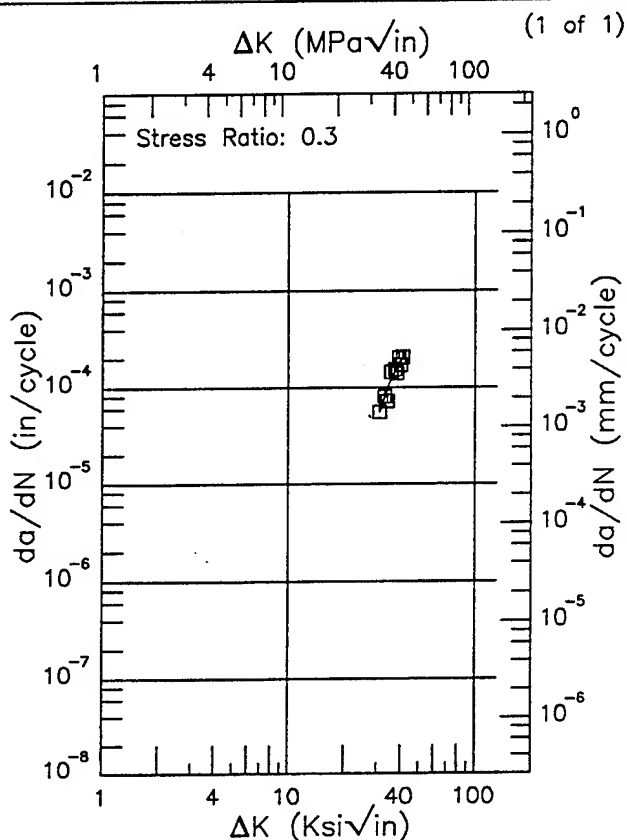
RMS %  
Error  
7.49

Life Prediction Ratio Summary  
□  
0. .5 .8 1.25 2.

Figure 6.16.3.1.68



Yield Strength: 134 ksi  
Ult. Strength: 145 ksi  
Specimen Thk: 0.5 in.  
Specimen Width: 6 in.  
Ref: 88579

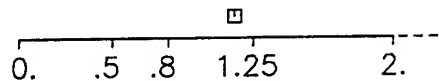


$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}\text{in/cycle}$ )
30.88 (min)	55.5
35.	116.
40.	196.
40.98 (max)	194.

$$\Delta K \text{ (Ksi}\sqrt{\text{in}}) \quad da/dN \text{ (10}^{-6}\text{in/cycle)}$$

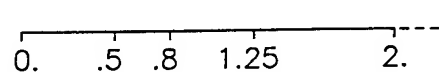
RMS %  
Error  
13.38

### Life Prediction Ratio Summary



RMS %  
Error

### Life Prediction Ratio Summary



**Figure 6.16.3.1.69**

Condition/Ht: HIP 1650F 15 KSI  
 Form: Casting  
 Specimen Type: CT  
 Orientation:  
 Frequency: 0.1 - 20 Hz  
 Environment: LAB AIR; RT

Yield Strength: 60 ksi  
 Ult. Strength:  
 Specimen Thk: 0.1 in.  
 Specimen Width: 0.999 - 1 in.  
 Ref: WL011

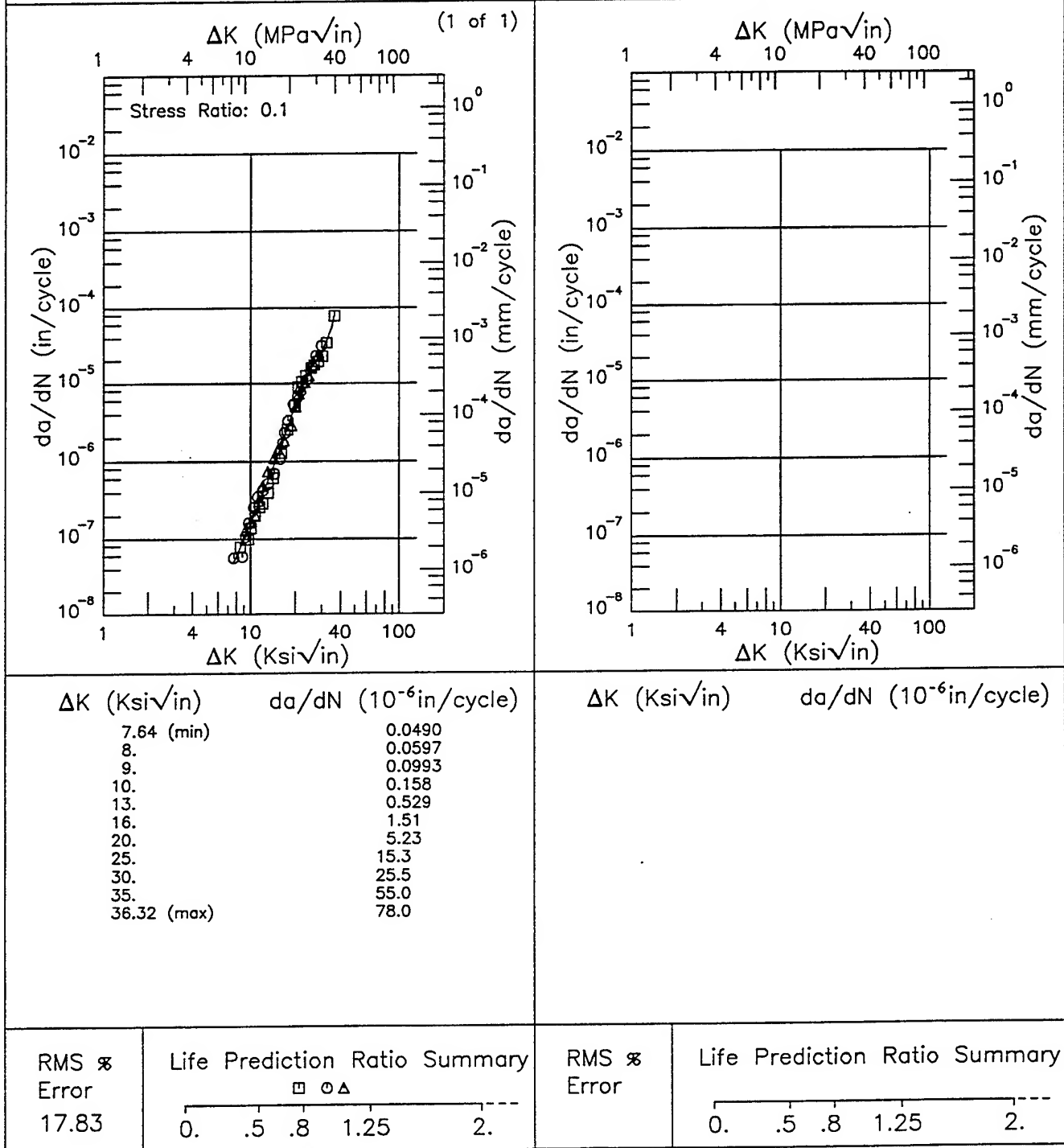
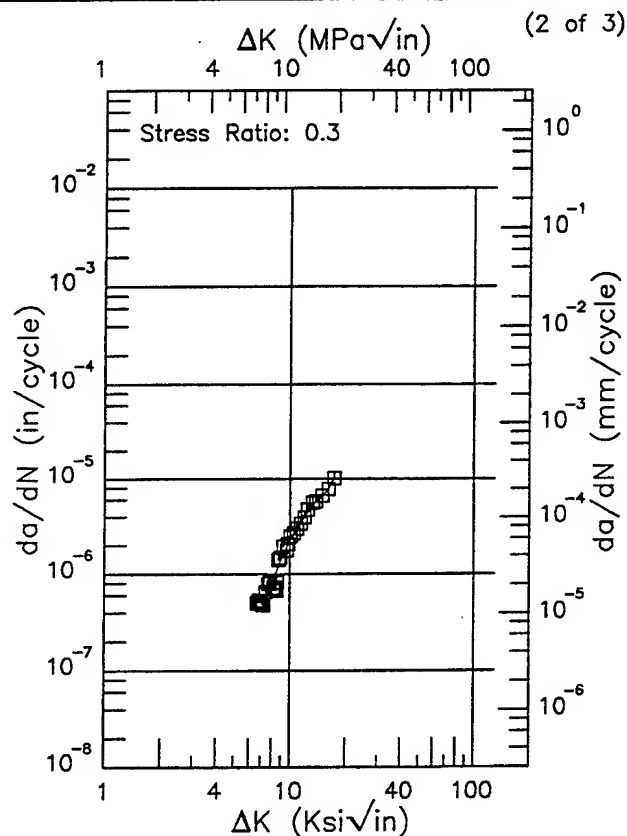
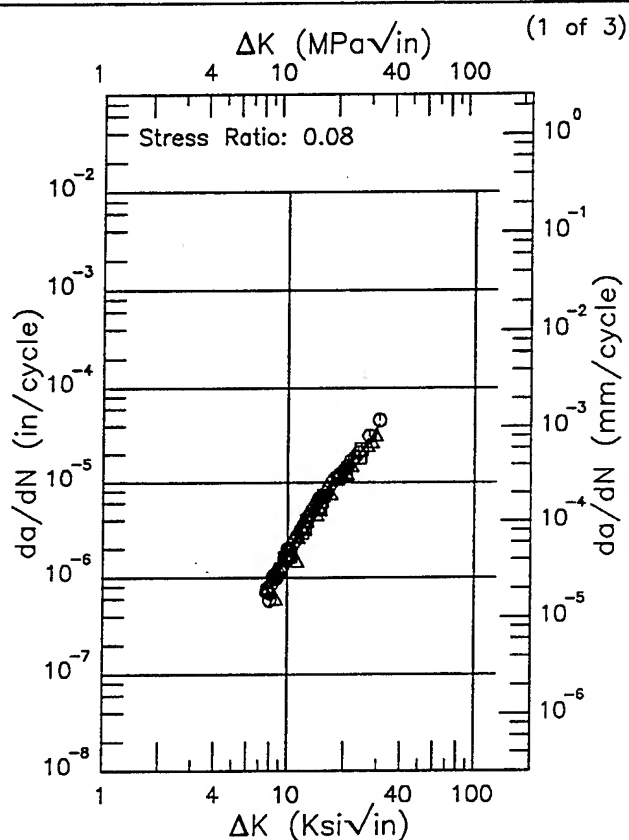


Figure 6.16.3.1.70

R Ti-6Al-4V  
 Condition/Ht: MA  
 Form: 0.1 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Frequency: 1 - 6 Hz  
 Environment: DRY AIR; RT

Yield Strength: 137 ksi  
 Ult. Strength: 147 ksi  
 Specimen Thk: 0.092 - 0.101 in.  
 Specimen Width: 23.98 - 24.22 in.  
 Ref: 86575



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
7.65 (min)	0.691
8.	0.785
9.	1.15
10.	1.67
13.	4.27
16.	7.80
20.	13.5
25.	22.3
30.	37.8
30.60 (max)	41.9

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
6.62 (min)	0.523
7.	0.511
8.	0.777
9.	1.43
10.	2.27
13.	5.06
16.	7.46
17.28 (max)	10.1

RMS %  
 Error  
 11.20

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

RMS %  
 Error  
 13.10

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

Figure 6.16.3.1.71

Ti-6Al-4V

R

Condition/Ht: MA  
Form: 0.1 in. Sheet  
Specimen Type: CCP (max load specified)  
Orientation: L-T  
Frequency: 1 - 6 Hz  
Environment: DRY AIR; RT

Yield Strength: 137 ksi  
Ult. Strength: 147 ksi  
Specimen Thk: 0.092 - 0.101 in.  
Specimen Width: 23.98 - 24.22 in.  
Ref: 86575

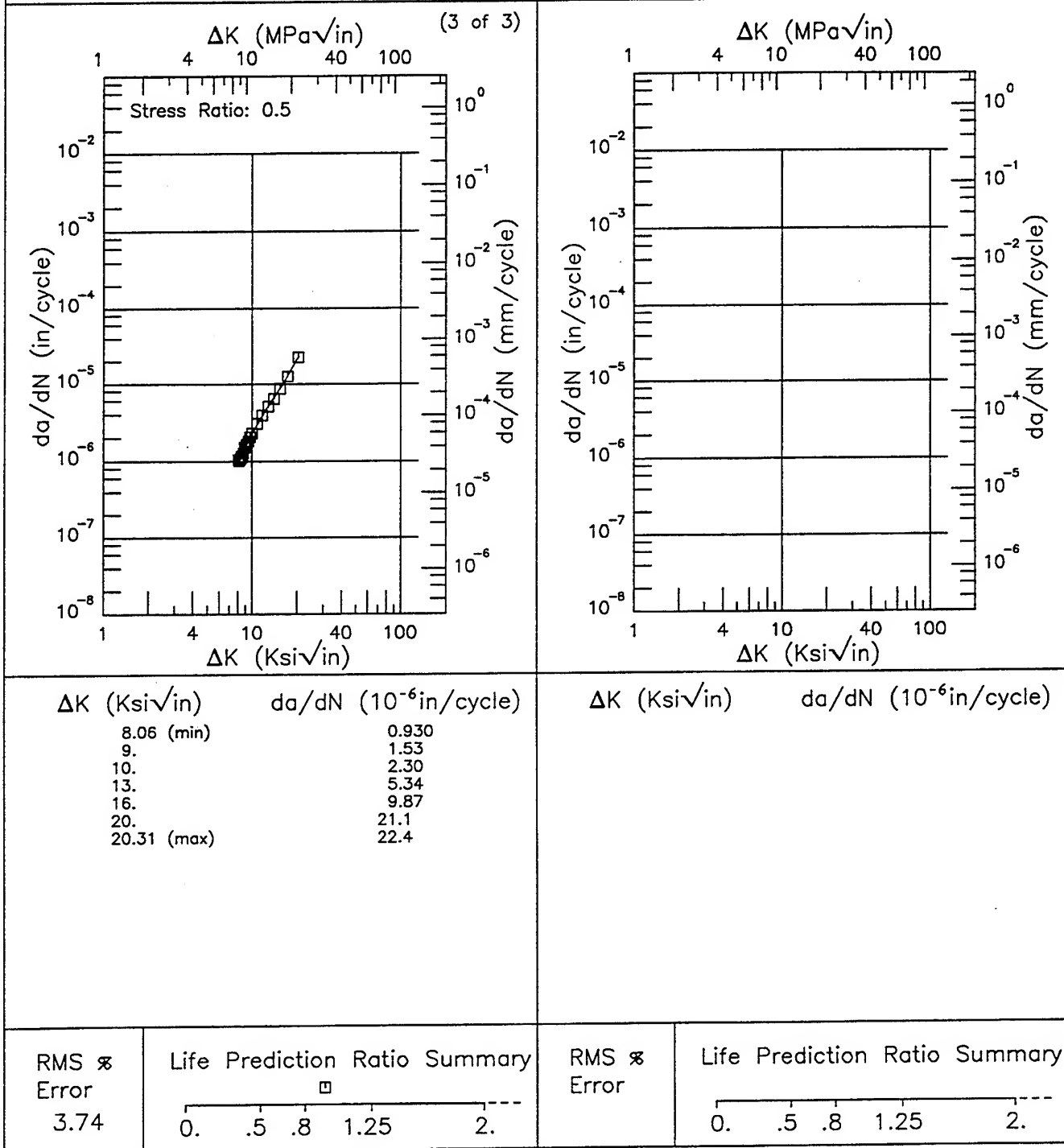


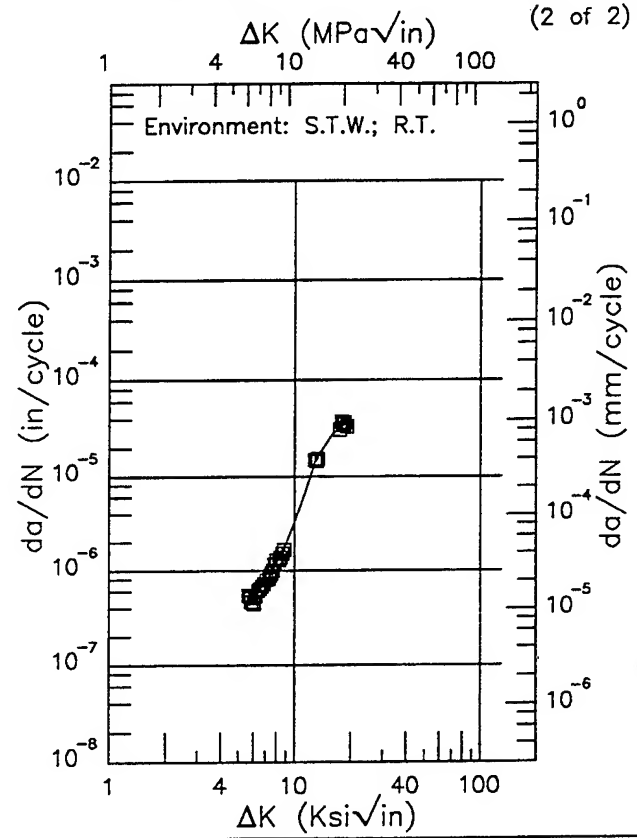
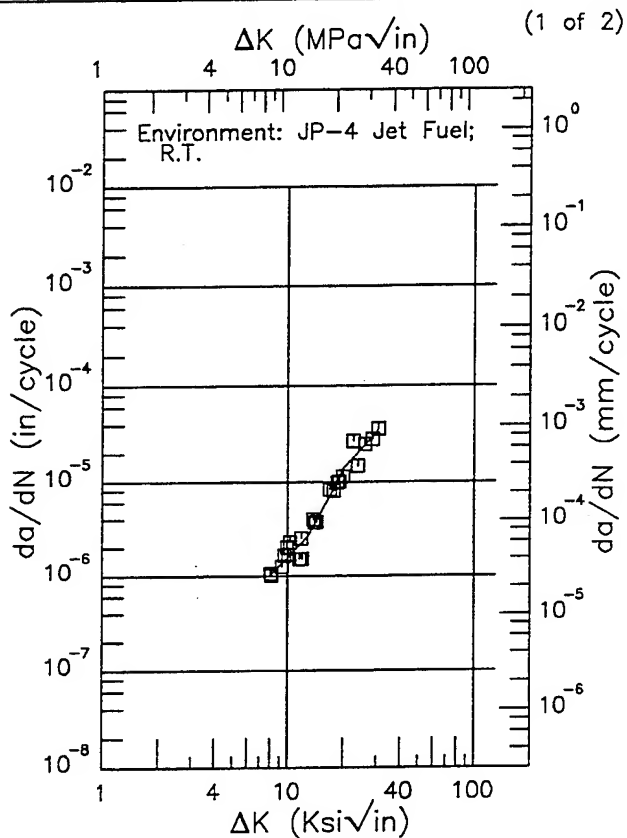
Figure 6.16.3.1.71 (Concluded)

Ti-6Al-4V

E

Condition/Ht: MA  
Form: 0.1 in. Sheet  
Specimen Type: CCP (max load specified)  
Orientation: L-T  
Stress Ratio: 0.08  
Frequency: 1 - 6 Hz

Yield Strength: 137 ksi  
Ult. Strength: 147 ksi  
Specimen Thk: 0.096 in.  
Specimen Width: 24 in.  
Ref: 86575



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.05 (min)	1.02
9.	1.30
10.	1.56
13.	2.68
16.	5.80
20.	13.9
25.	22.7
30.	33.0
30.58 (max)	35.9

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
5.67 (min)	0.447
6.	0.504
7.	0.747
8.	1.16
9.	1.90
10.	3.24
13.	15.0
16.	28.2
19.01 (max)	37.2

RMS %  
Error  
19.82

Life Prediction Ratio Summary  
0. 0.5 0.8 1.25 2.

RMS %  
Error  
6.84

Life Prediction Ratio Summary  
0. 0.5 0.8 1.25 2.

Figure 6.16.3.1.72

Condition/Ht: MA  
 Form: 0.1 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation: T-L  
 Stress Ratio: 0.08  
 Frequency: 6 Hz

Yield Strength: 143 ksi  
 Ult. Strength: 151 ksi  
 Specimen Thk: 0.096 - 0.097 in.  
 Specimen Width: 24 in.  
 Ref: 86575

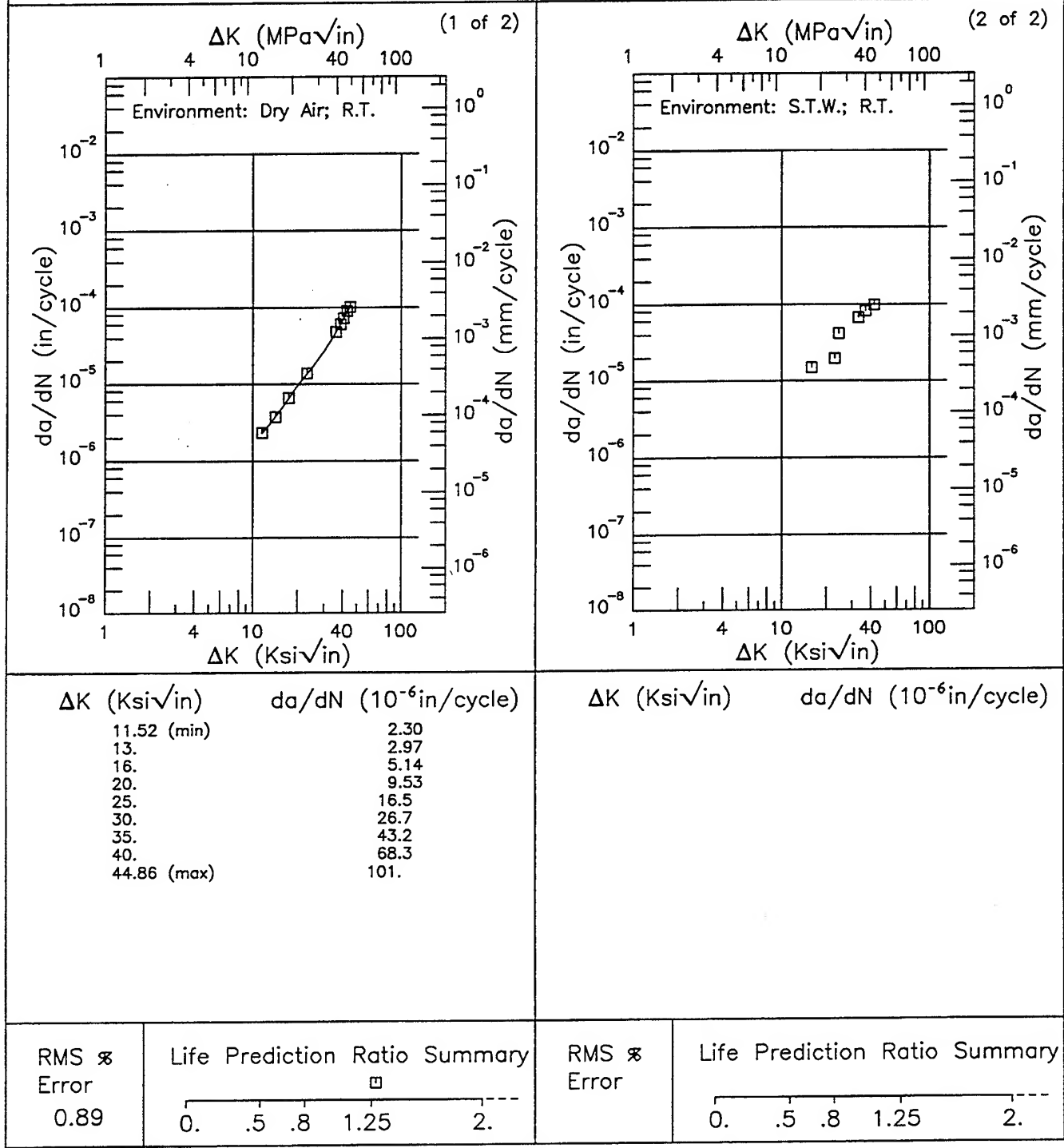


Figure 6.16.3.1.73

R

Ti-6Al-4V

Condition/Ht: MA  
 Form: 0.75 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 20 Hz  
 Environment: LAB AIR; RT

Yield Strength: 135.3 ksi  
 Ult. Strength: 137.6 ksi  
 Specimen Thk: 0.25 in.  
 Specimen Width: 2.5 in.  
 Ref: 88468

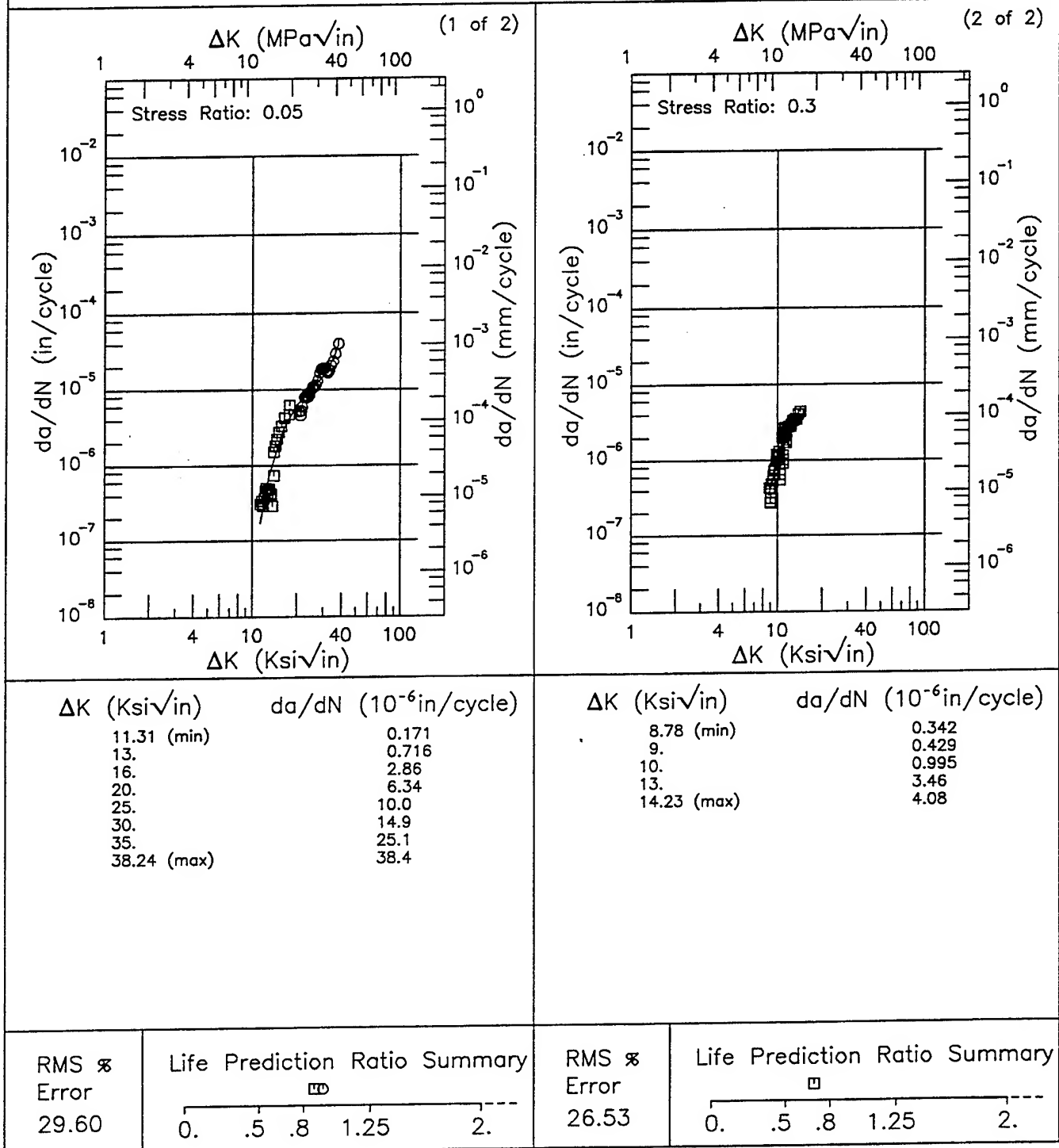


Figure 6.16.3.1.74

Ti-6Al-4V

E

Condition/Ht: MA  
 Form: 0.63 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.3  
 Frequency: 1 Hz

Yield Strength: 138 ksi  
 Ult. Strength: 148 ksi  
 Specimen Thk: 0.49 - 0.5 in.  
 Specimen Width: 6 in.  
 Ref: 88579

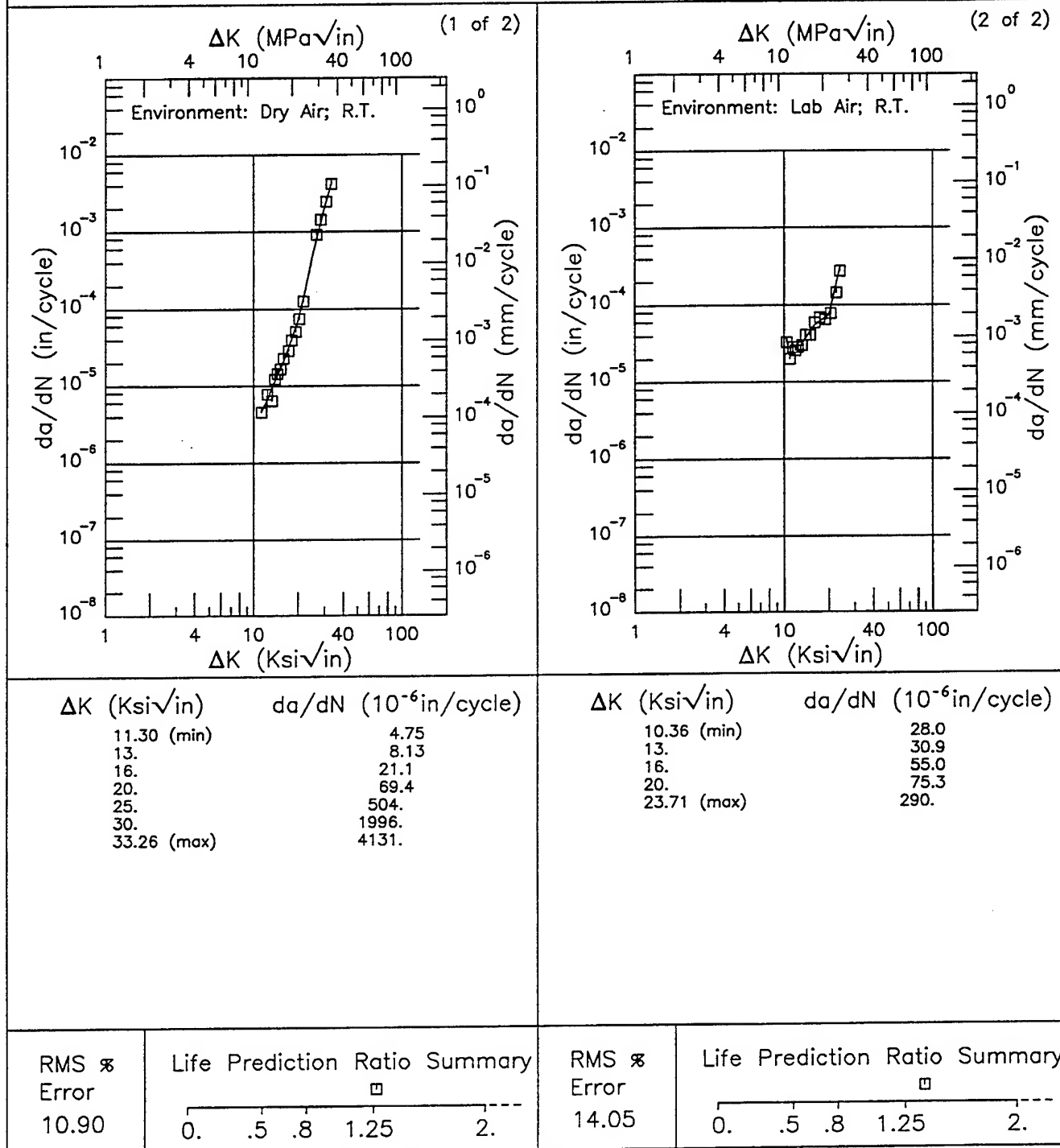
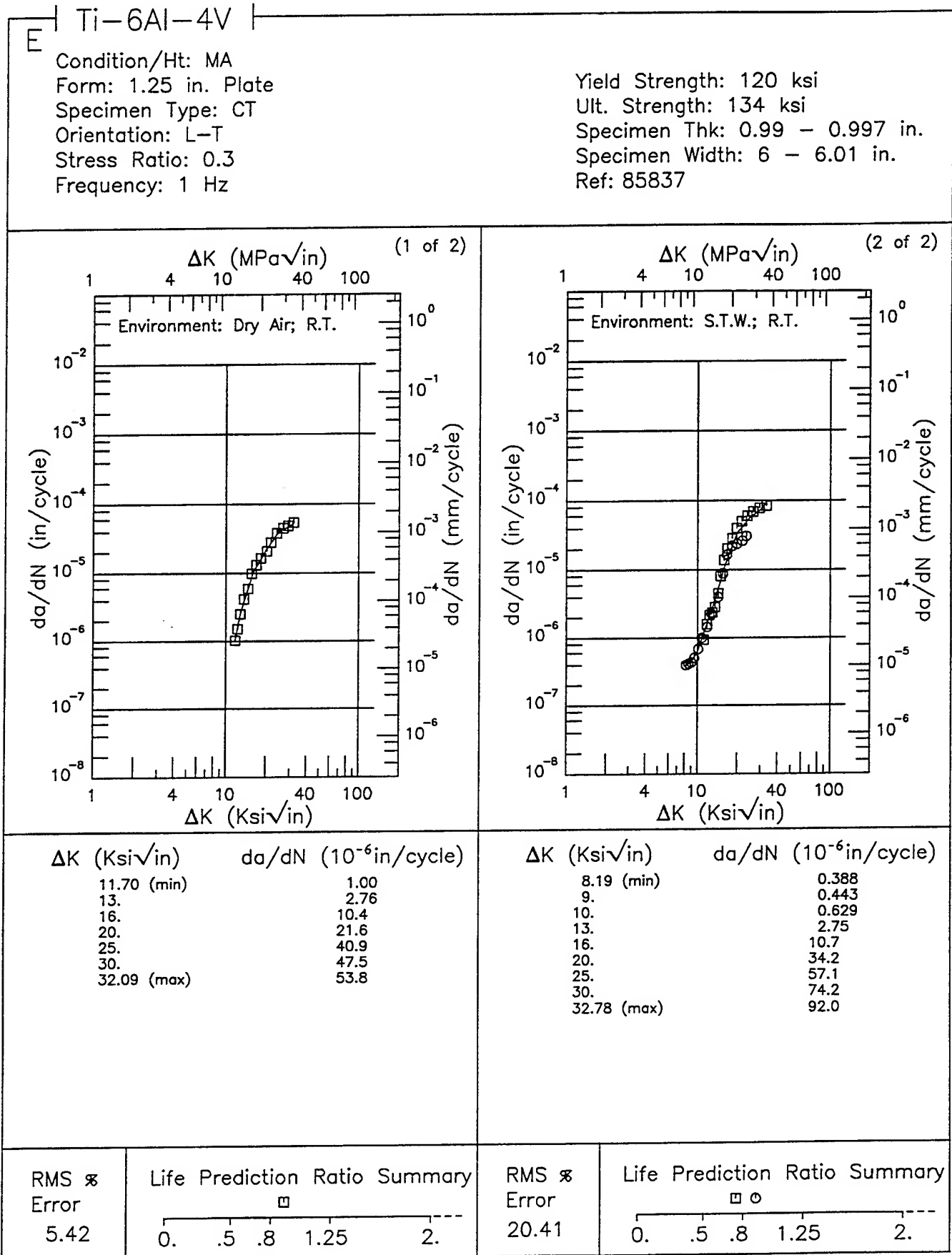


Figure 6.16.3.1.75





**Figure 6.16.3.1.76**

Condition/Ht: MA  
Form: 0.63 - 1.5 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.3  
Environment: DRY AIR; RT

Yield Strength: 120 - 138 ksi  
Ult. Strength: 134 - 148 ksi  
Specimen Thk: 0.67 - 1 in.  
Specimen Width: 6 in.  
Ref: 88579;84361;85837

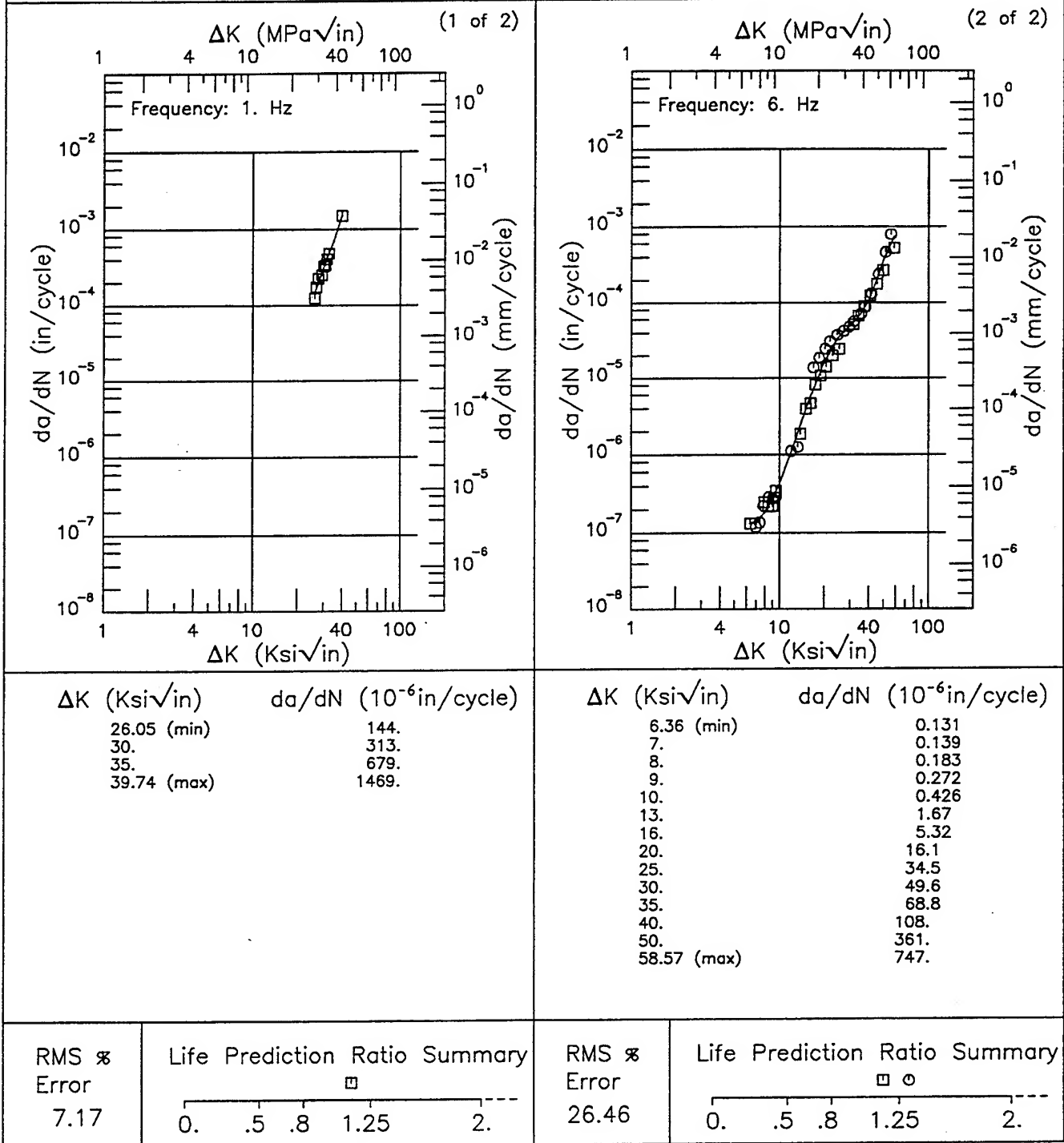


Figure 6.16.3.1.77

EF | Ti-6Al-4V |

Condition/Ht: MA  
Form: 1 in. Plate  
Specimen Type: CT  
Orientation: T-L  
Stress Ratio: 0.1

Yield Strength:  
Ult. Strength:  
Specimen Thk: 1 in.  
Specimen Width: 2.55 in.  
Ref: 88144

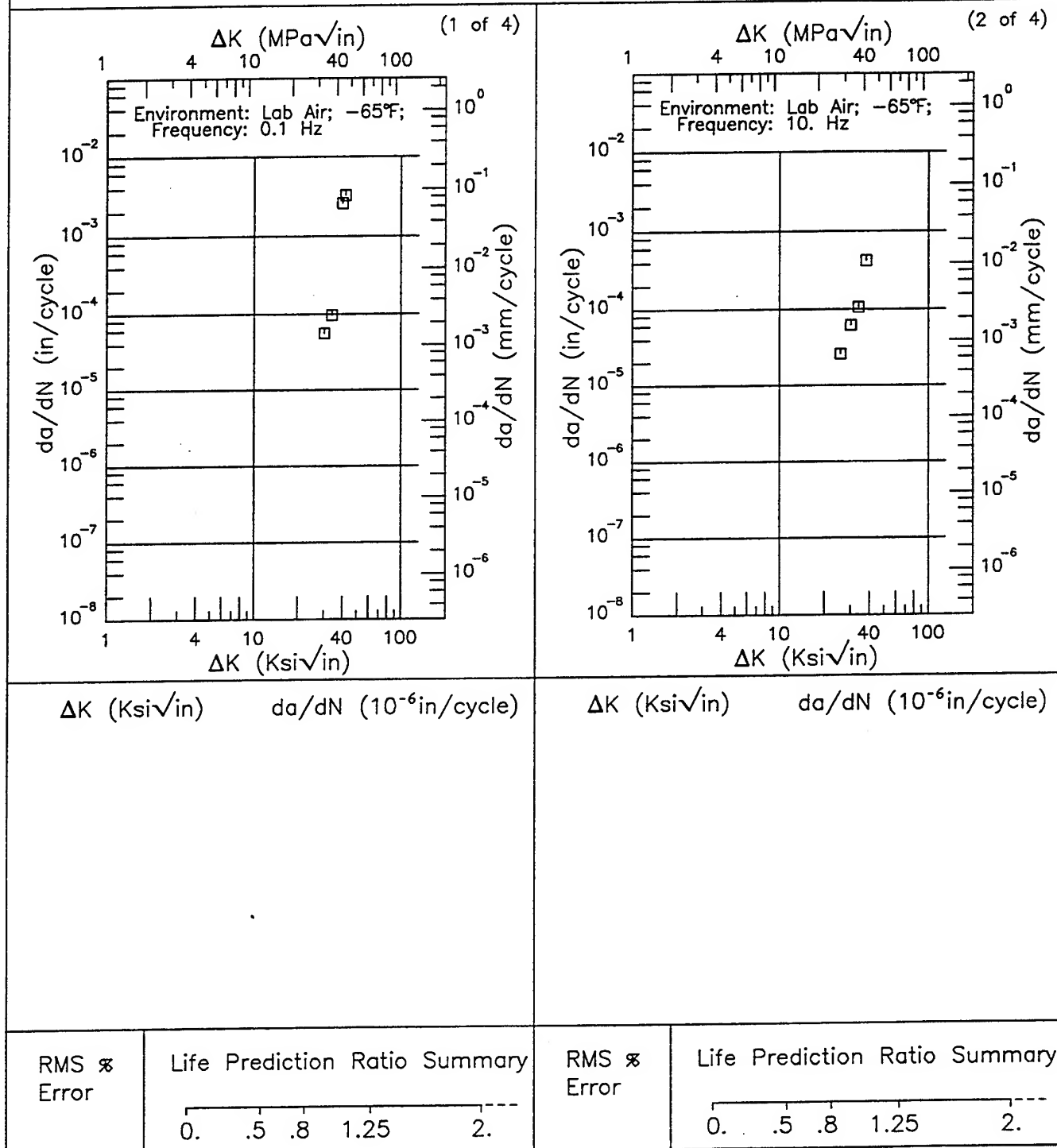


Figure 6.16.3.1.78

Condition/Ht: MA  
Form: 1 in. Plate  
Specimen Type: CT  
Orientation: T-L  
Stress Ratio: 0.1

Yield Strength:  
Ult. Strength:  
Specimen Thk: 1 in.  
Specimen Width: 2.55 in.  
Ref: 88144

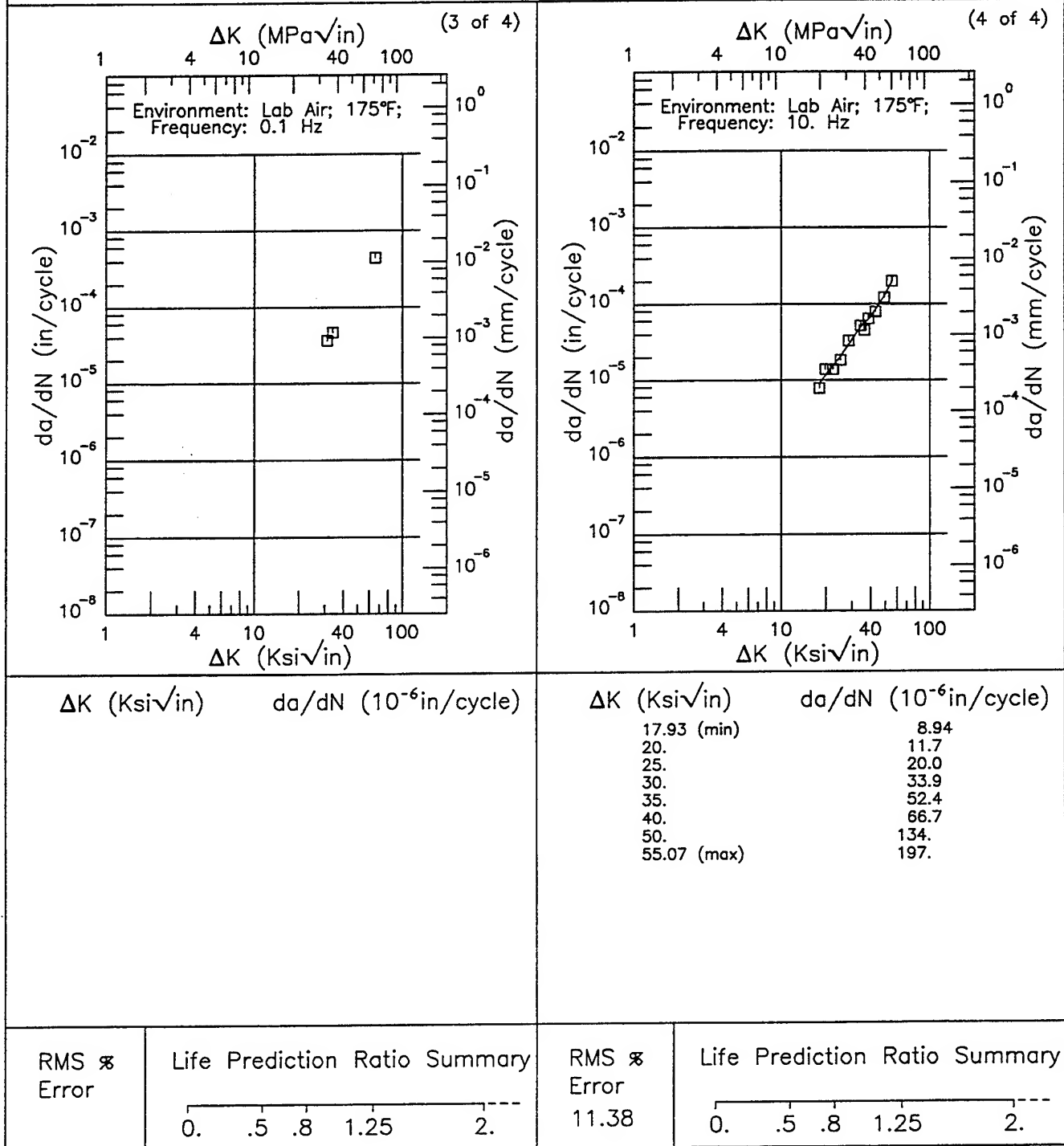


Figure 6.16.3.1.78 (Concluded)

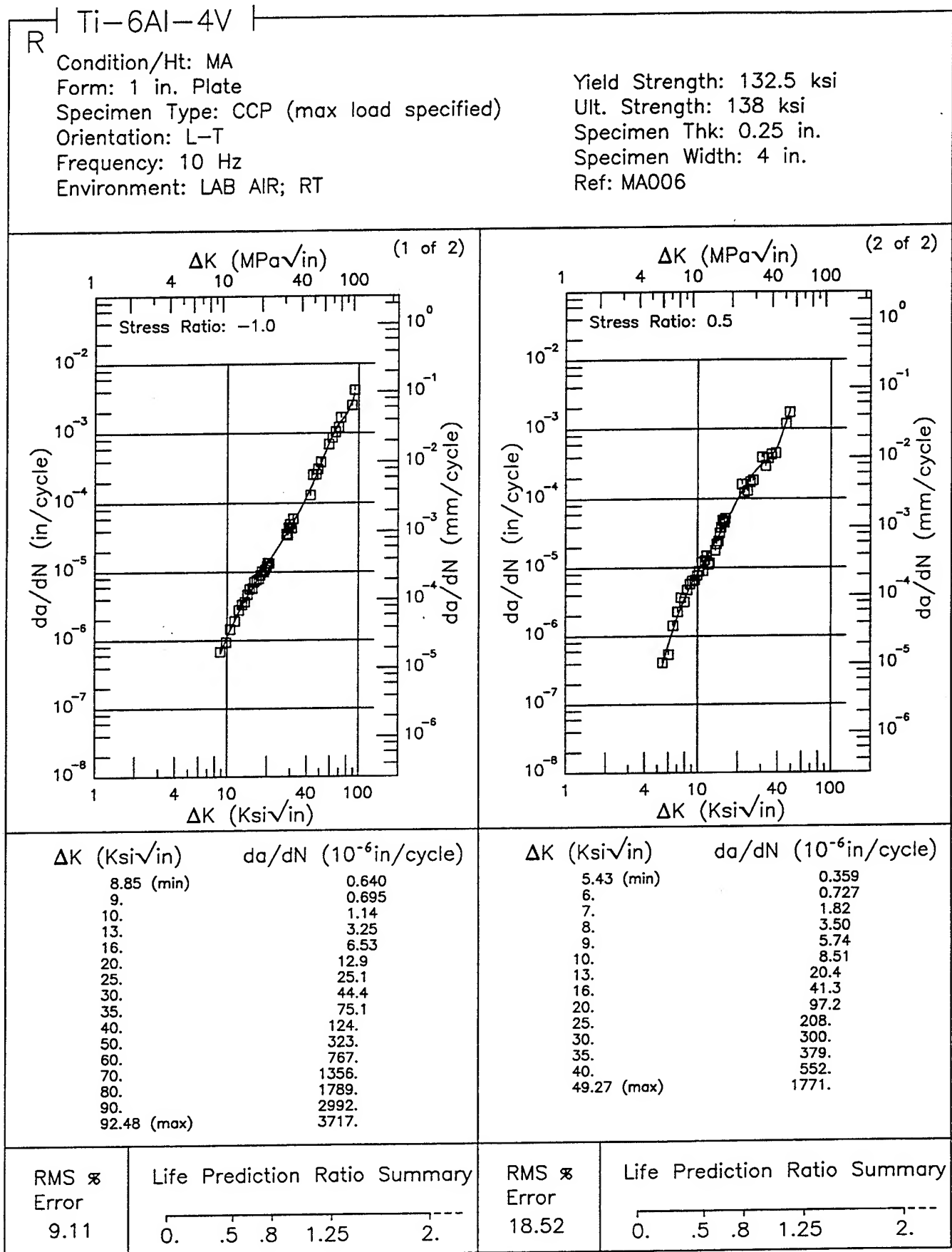


Figure 6.16.3.1.79

Ti-6Al-4V F

Condition/Ht: MA  
 Form: 0.38 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Stress Ratio: 0.02  
 Environment: LAB AIR; RT

Yield Strength: 137 ksi  
 Ult. Strength: 145 ksi  
 Specimen Thk: 0.241 - 0.242 in.  
 Specimen Width: 3.952 - 3.953 in.  
 Ref: MA002

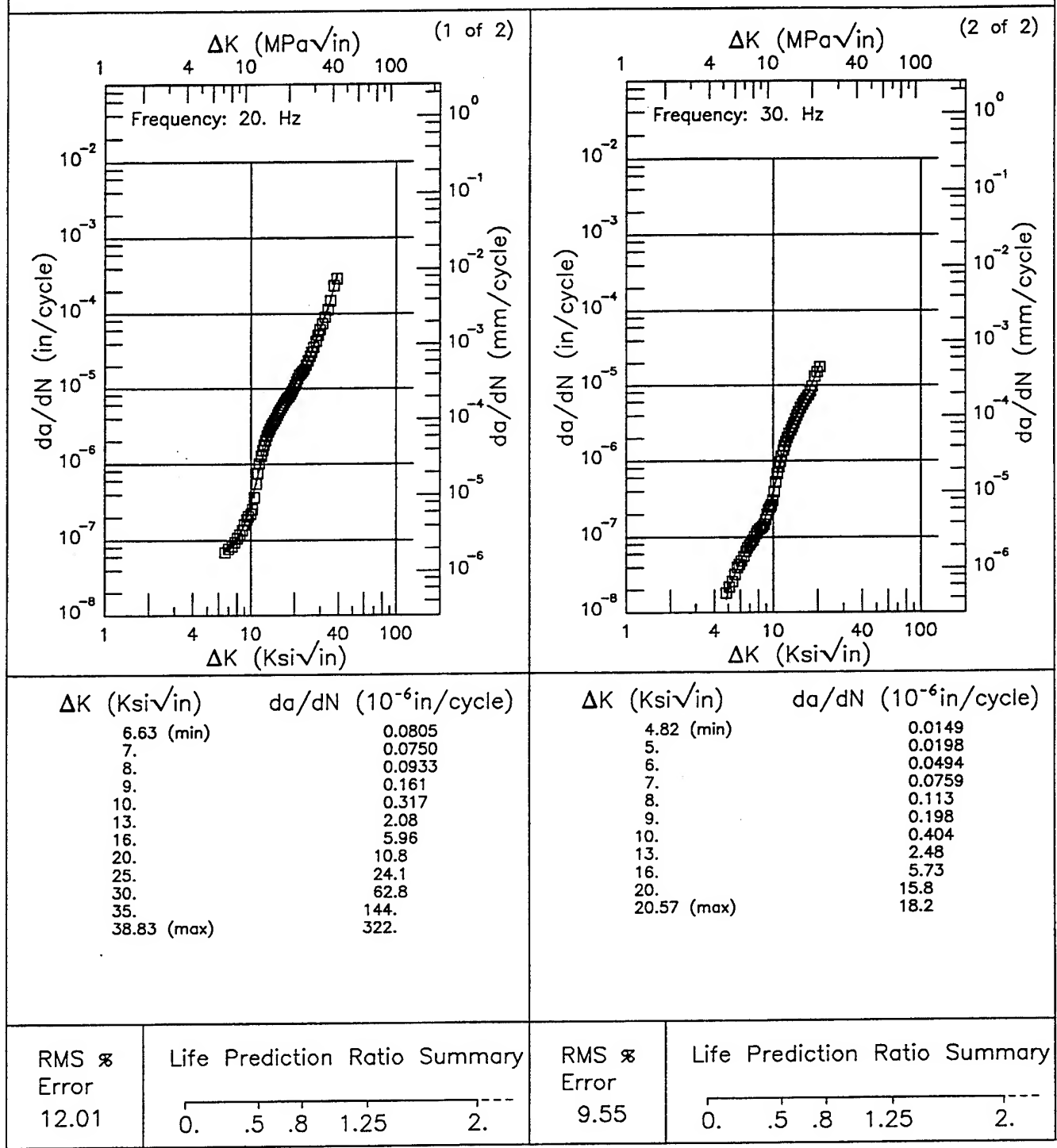
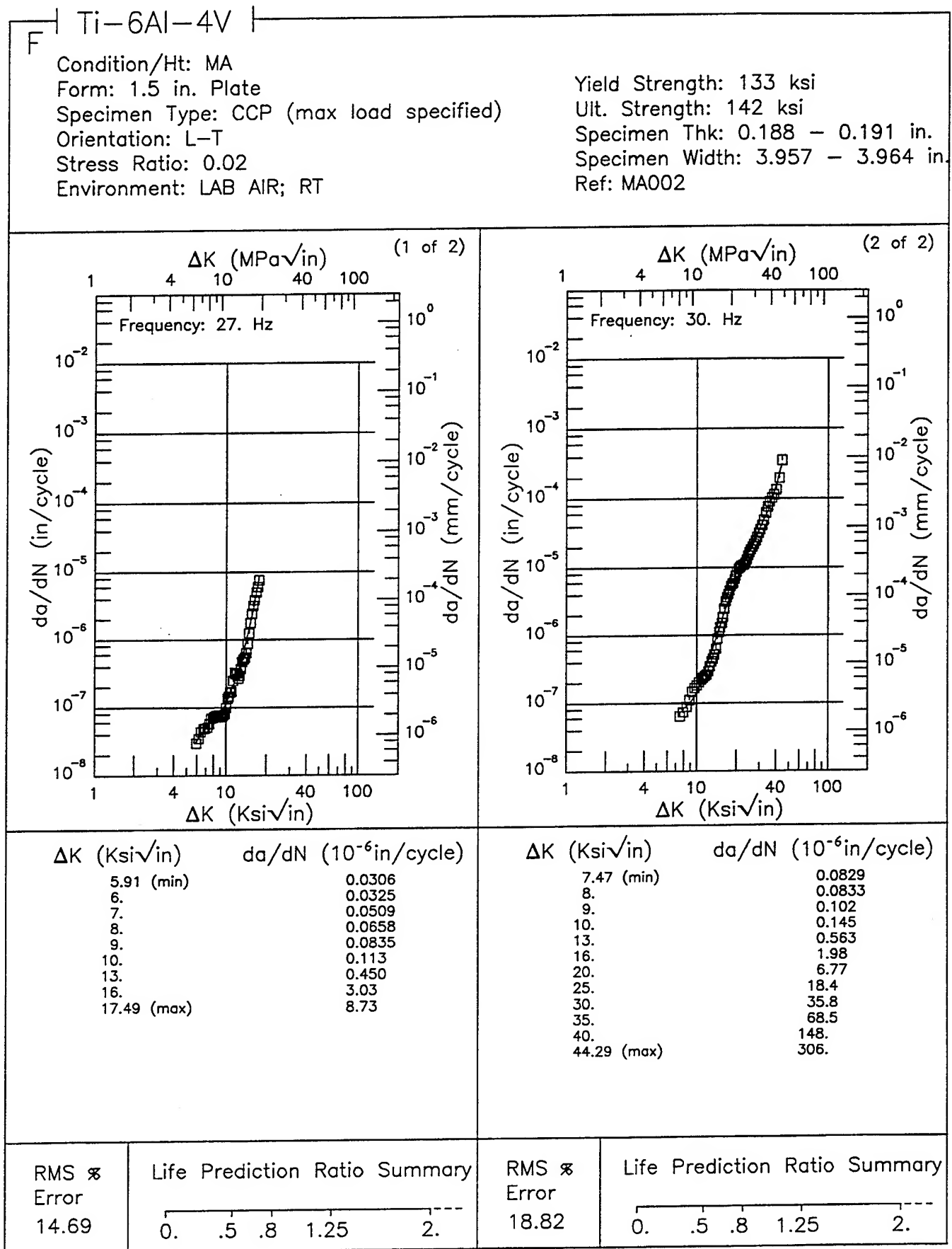


Figure 6.16.3.1.80

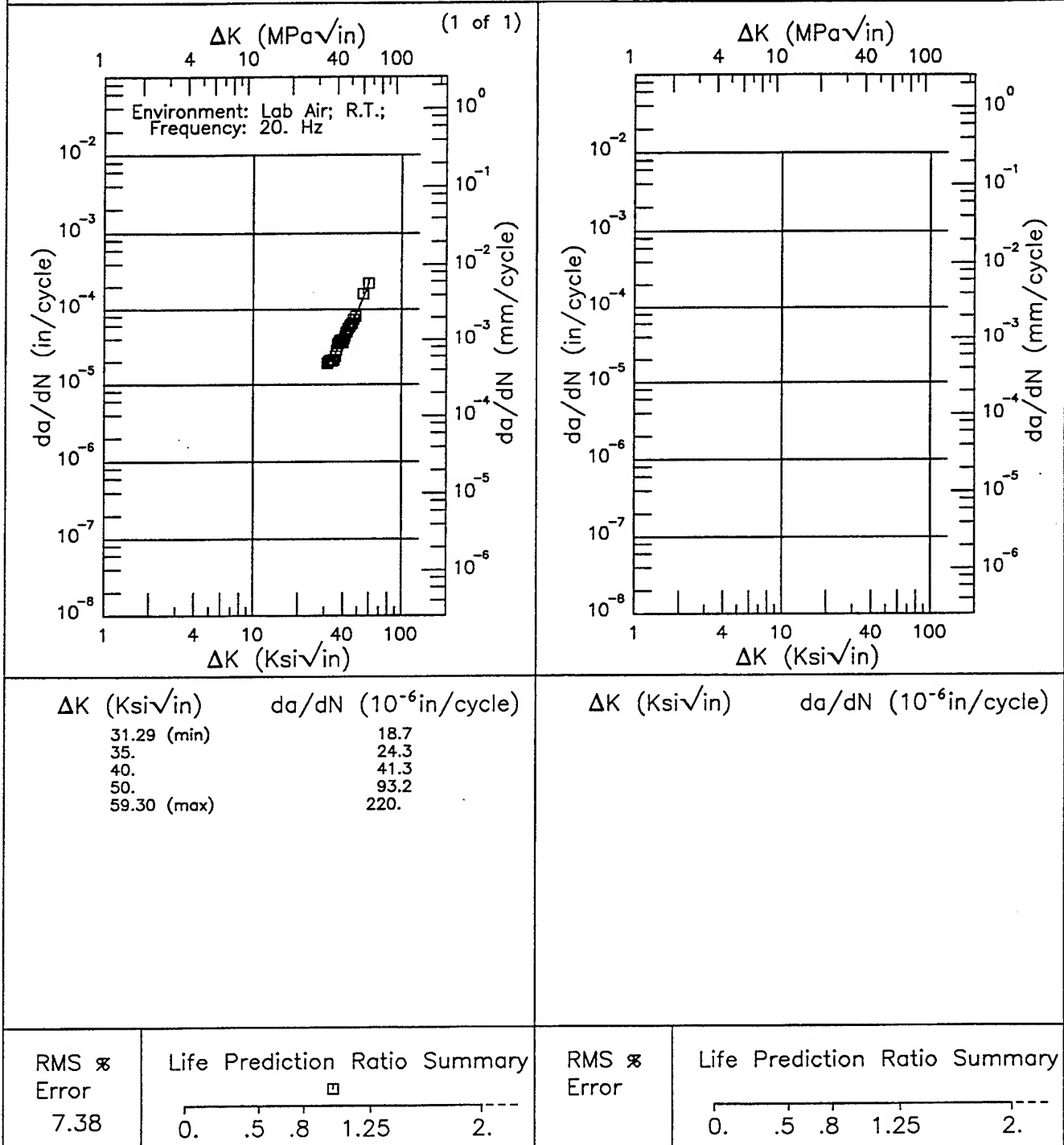


**Figure 6.16.3.1.81**

Ti-6Al-4V EF

Condition/Ht: MA  
Form: 0.75 in. Plate  
Specimen Type: CCP (max load specified)  
Orientation: L-T  
Stress Ratio: 0.04

Yield Strength: 135.3 ksi  
Ult. Strength: 137.6 ksi  
Specimen Thk: 0.29 in.  
Specimen Width: 6.011 in.  
Ref: 88468

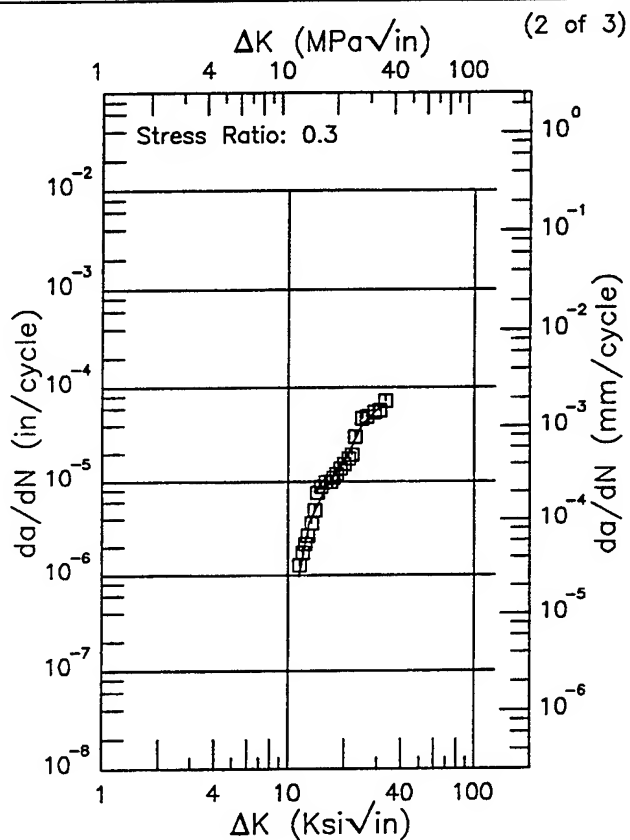
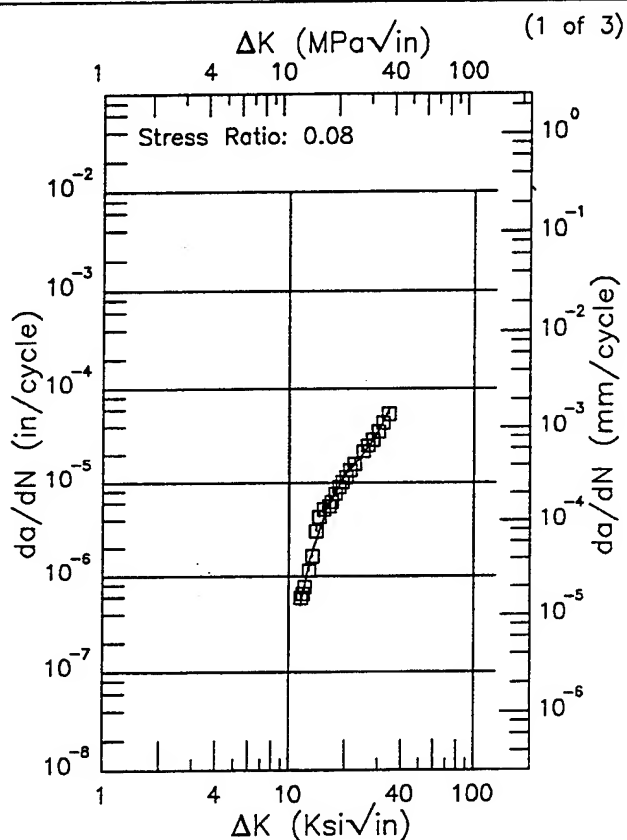


**Figure 6.16.3.1.82**



R | Ti-6Al-4V |  
 Condition/Ht: MA  
 Form: Extrusion  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 6 Hz  
 Environment: DRY AIR; RT

Yield Strength: 123.5 ksi  
 Ult. Strength: 135.5 ksi  
 Specimen Thk: 0.993 - 0.995 in.  
 Specimen Width: 3.77 in.  
 Ref: 85837



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
11.52 (min)	0.496
13.	1.51
16.	5.47
20.	12.0
25.	20.6
30.	34.7
34.01 (max)	58.3

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
11.48 (min)	0.973
13.	3.65
16.	8.87
20.	16.4
25.	41.2
30.	59.0
32.86 (max)	68.4

RMS %  
 Error  
 13.66

Life Prediction Ratio Summary  
  
 0. .5 .8 1.25 2.

RMS %  
 Error  
 14.94

Life Prediction Ratio Summary  
  
 0. .5 .8 1.25 2.

Figure 6.16.3.1.83

Condition/Ht: MA  
 Form: Extrusion  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 6 Hz  
 Environment: DRY AIR; RT

Yield Strength: 123.5 ksi  
 Ult. Strength: 135.5 ksi  
 Specimen Thk: 0.993 - 0.995 in.  
 Specimen Width: 3.77 in.  
 Ref: 85837

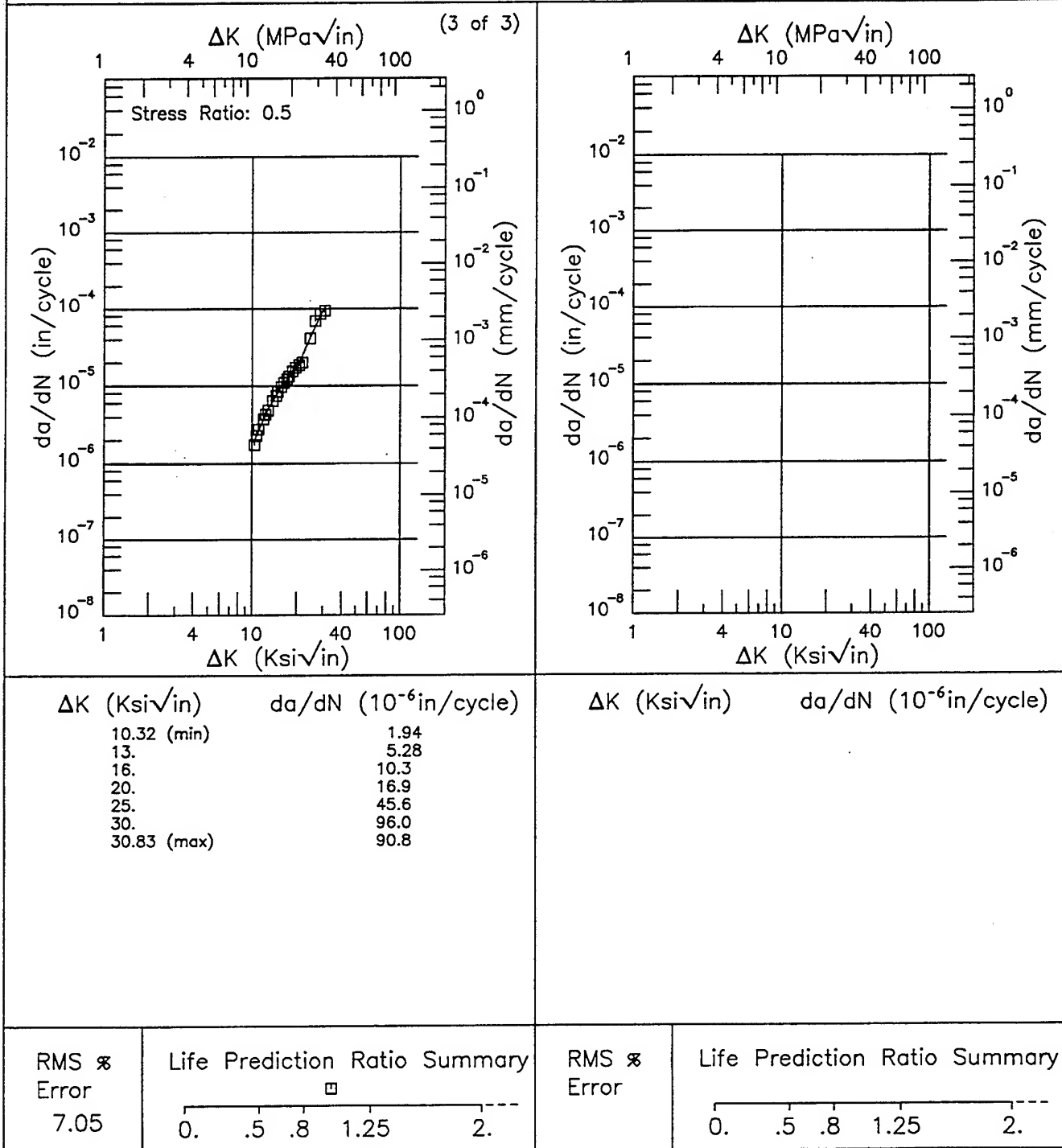


Figure 6.16.3.1.83 (Concluded)

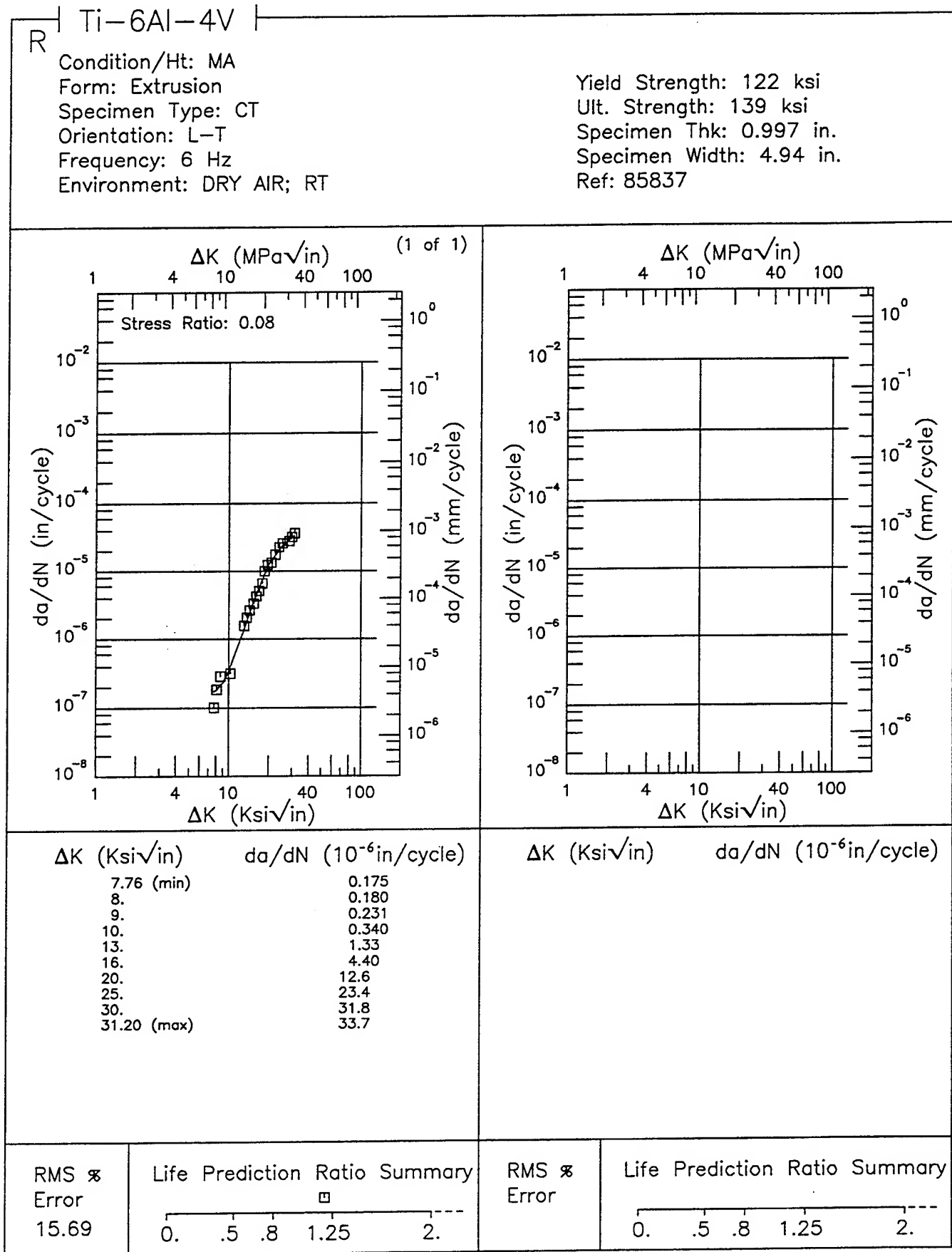
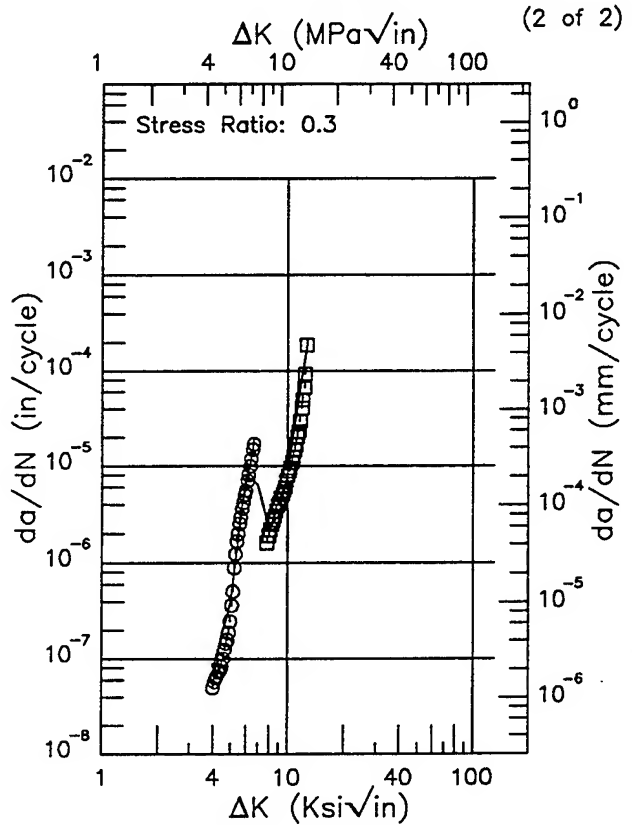
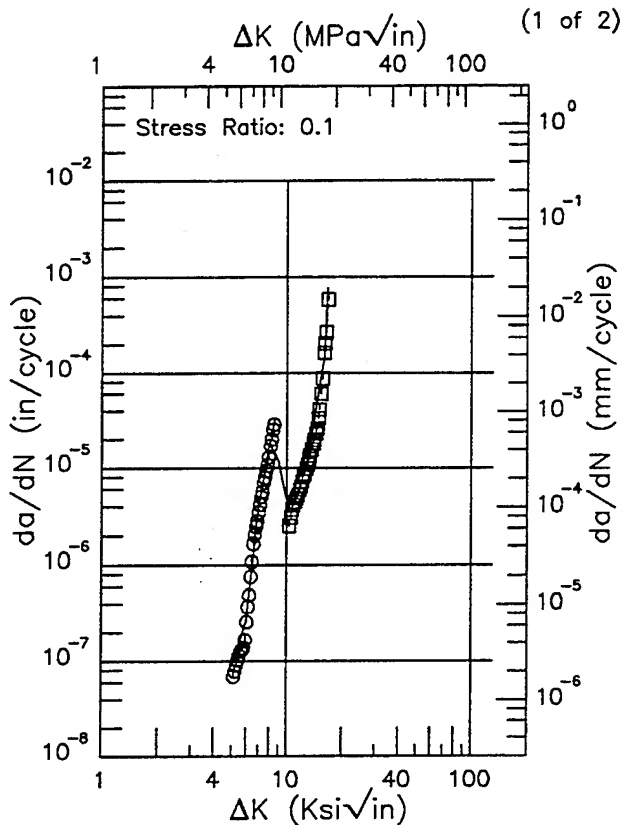


Figure 6.16.3.1.84

Condition/Ht: MA  
Form: Extrusion  
Specimen Type: CT  
Orientation: L-T  
Frequency: 10 Hz  
Environment: LAB AIR; RT

Yield Strength:  
Ult. Strength:  
Specimen Thk: 0.251 in.  
Specimen Width: 2 in.  
Ref: NC005



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
5.10 (min)	0.0946
6.	0.259
7.	4.01
8.	18.2
9.	11.9
10.	4.64
13.	11.9
16.	152.
16.69 (max)	778.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
3.97 (min)	0.0878
4.	0.0802
5.	0.394
6.	8.21
7.	6.36
8.	2.22
9.	3.07
10.	8.82
12.66 (max)	210.

RMS %  
Error  
29.84

Life Prediction Ratio Summary

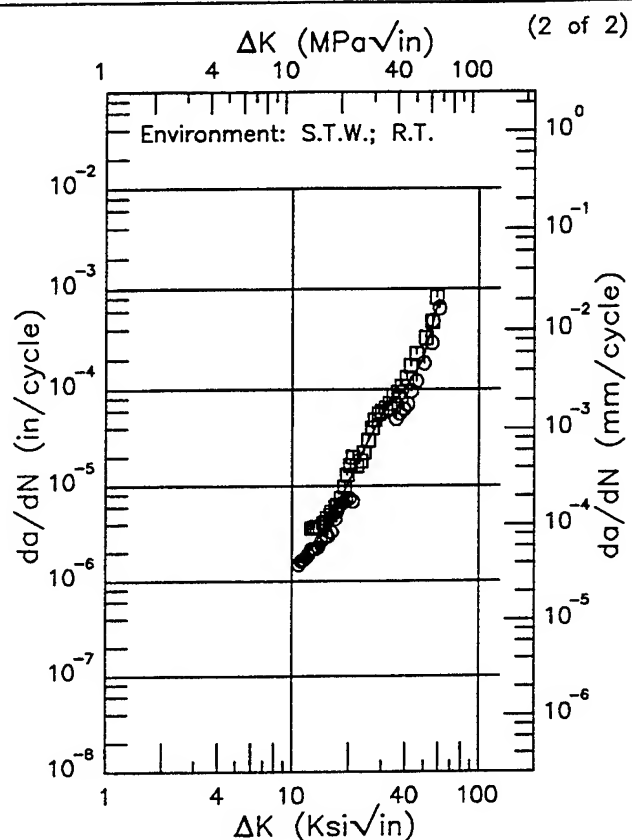
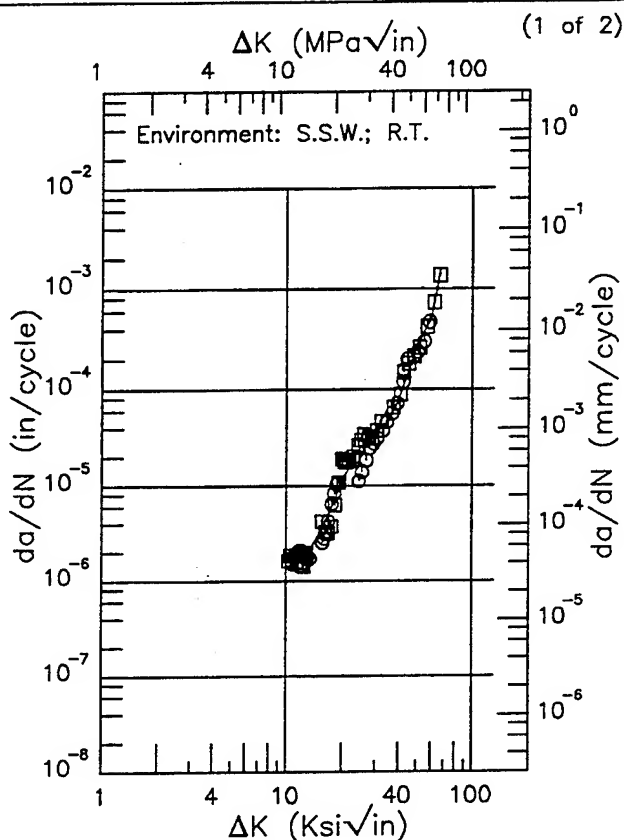
RMS %  
Error  
40.20

Life Prediction Ratio Summary

Figure 6.16.3.1.85

Condition/Ht: MA  
Form: 1.8 in. Extrusion  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.1  
Frequency: 1 - 10 Hz

Yield Strength: 124.4 ksi  
Ult. Strength: 135.3 ksi  
Specimen Thk: 1.001 - 1.003 in.  
Specimen Width: 4.5 in.  
Ref: NC002

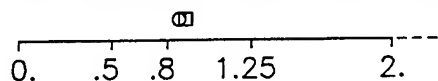


$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}\text{in/cycle}$ )
10.22 (min)	1.83
13.	1.87
16.	3.96
20.	11.4
25.	25.6
30.	34.7
35.	46.8
40.	78.9
50.	270.
60.	512.
66.66 (max)	1477.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}\text{in/cycle}$ )
10.86 (min)	1.62
13.	2.30
16.	4.47
20.	10.9
25.	27.5
30.	53.2
35.	79.7
40.	98.8
50.	210.
60.	727.
60.69 (max)	779.

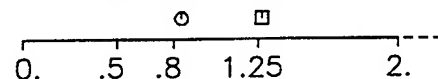
RMS Error  
21.82

### Life Prediction Ratio Summary



RMS Error  
24.03

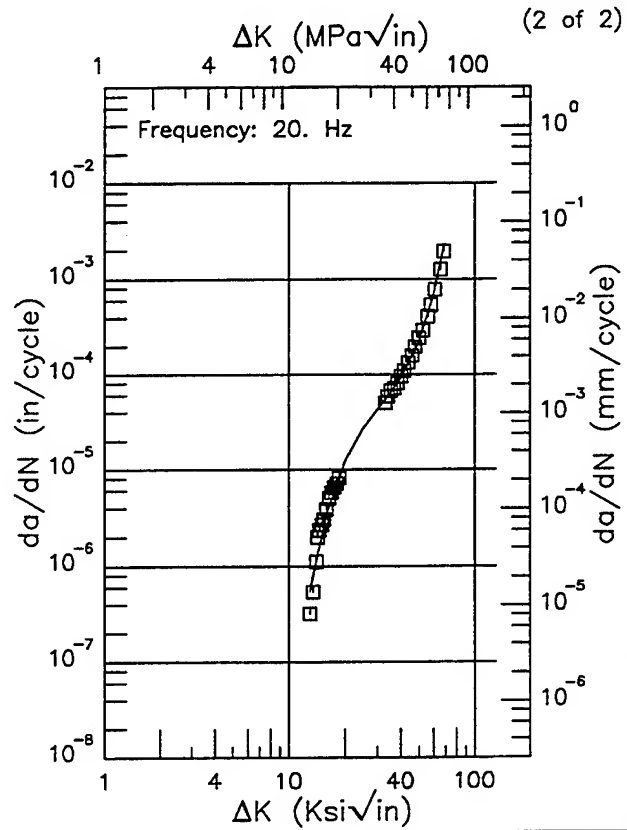
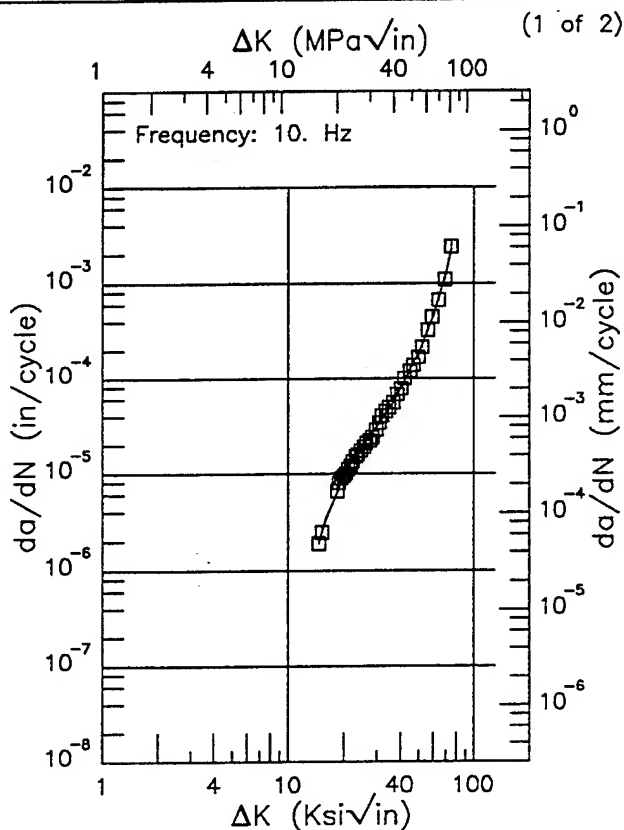
### Life Prediction Ratio Summary



**Figure 6.16.3.1.86**

Condition/Ht: MA  
Form: 1.8 in. Extrusion  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.1  
Environment: LAB AIR; RT

Yield Strength: 124.4 ksi  
Ult. Strength: 135.3 ksi  
Specimen Thk: 1 - 1.002 in.  
Specimen Width: 4.5 in.  
Ref: NC002



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
14.66 (min)	2.01
16.	3.39
20.	9.35
25.	19.0
30.	31.0
35.	48.5
40.	76.4
50.	189.
60.	453.
70.	1240.
74.97 (max)	2288.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.95 (min)	0.540
13.	0.563
16.	3.46
20.	12.2
25.	26.8
30.	42.7
35.	62.3
40.	91.3
50.	226.
60.	702.
67.89 (max)	1997.

RMS %  
Error  
6.26

Life Prediction Ratio Summary  
□  
0. .5 .8 1.25 2.

RMS %  
Error  
20.89

Life Prediction Ratio Summary  
□  
0. .5 .8 1.25 2.

Figure 6.16.3.1.87

EF Ti-6Al-4V

Condition/Ht: MA  
Form: Extrusion  
Specimen Type: CT  
Orientation: T-L  
Stress Ratio: 0.08

Yield Strength: 125 ksi  
Ult. Strength: 142 ksi  
Specimen Thk: 0.994 in.  
Specimen Width: 3.77 in.  
Ref: 85837

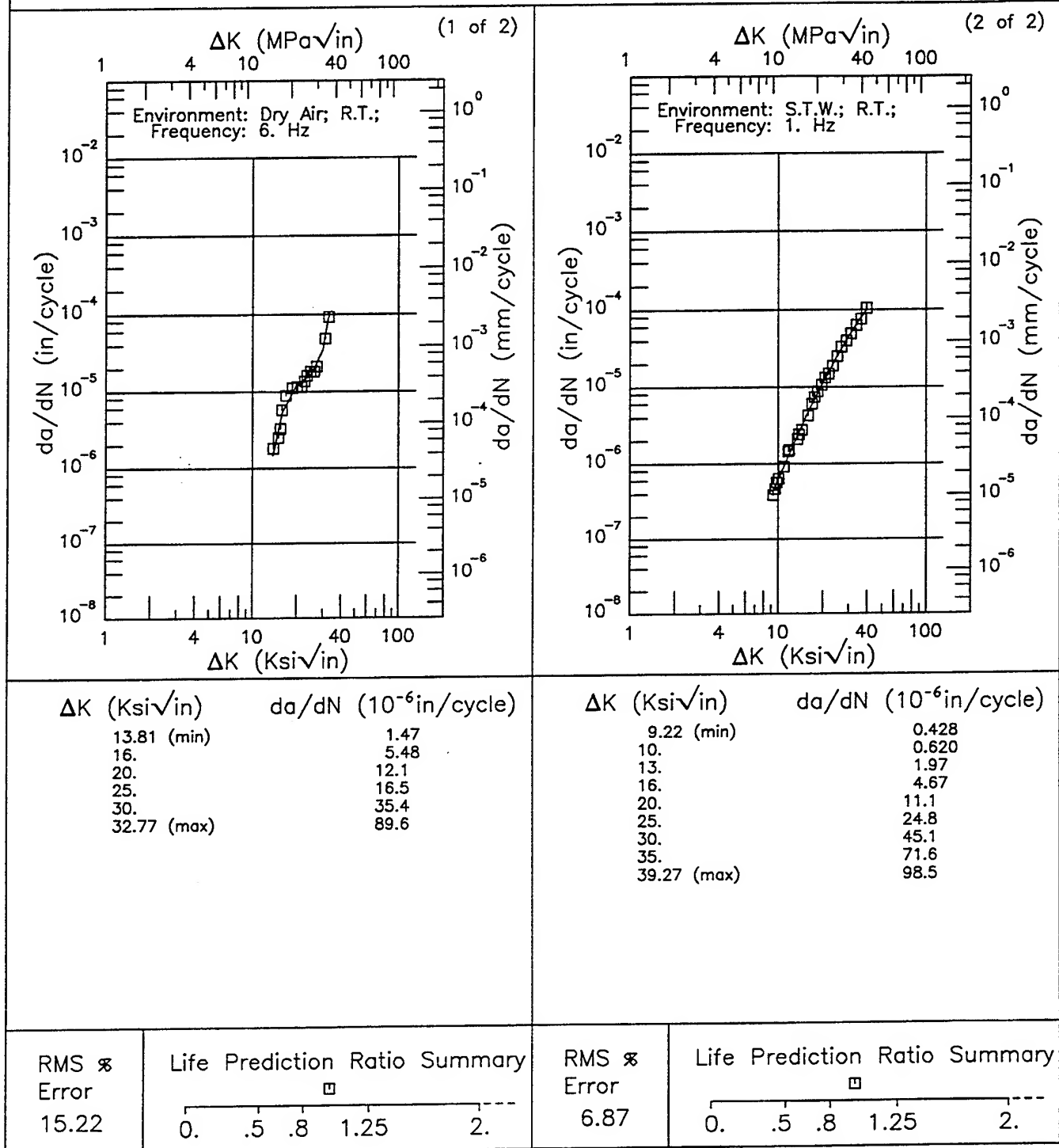


Figure 6.16.3.1.88

**This page intentionally left blank**



EF

Ti-6Al-4V

Condition/Ht: MA

Form: 1.8 in. Extrusion

Specimen Type: CT

Orientation: T-L

Stress Ratio: 0.1

Yield Strength: 126.6 ksi

Ult. Strength: 138.6 ksi

Specimen Thk: 1 - 1.003 in.

Specimen Width: 4.5 in.

Ref: NC002

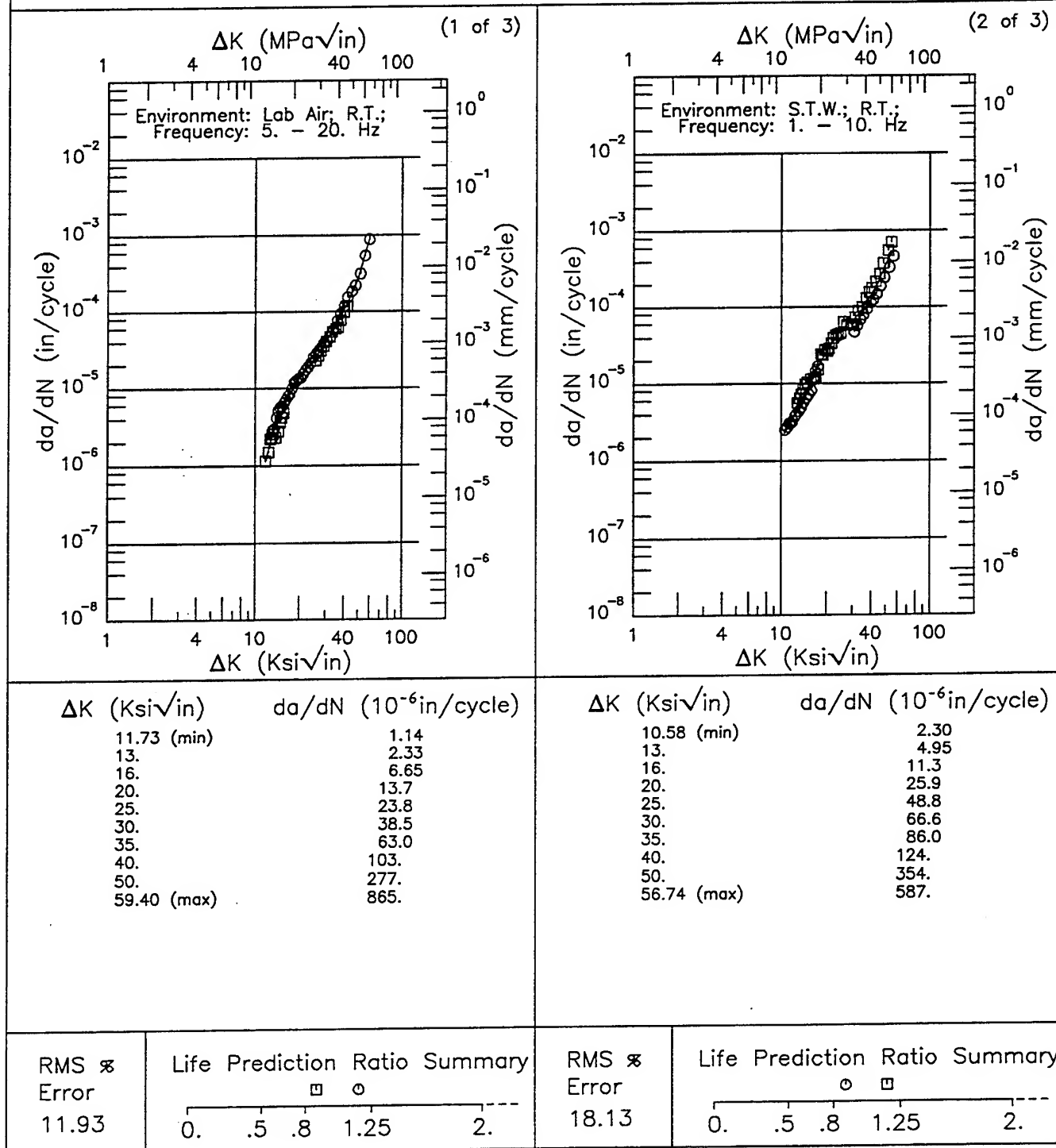


Figure 6.16.3.1.89

Condition/Ht: MA  
Form: 1.8 in. Extrusion  
Specimen Type: CT  
Orientation: T-L  
Stress Ratio: 0.1

Yield Strength: 126.6 ksi  
Ult. Strength: 138.6 ksi  
Specimen Thk: 1 - 1.003 in.  
Specimen Width: 4.5 in.  
Ref: NC002

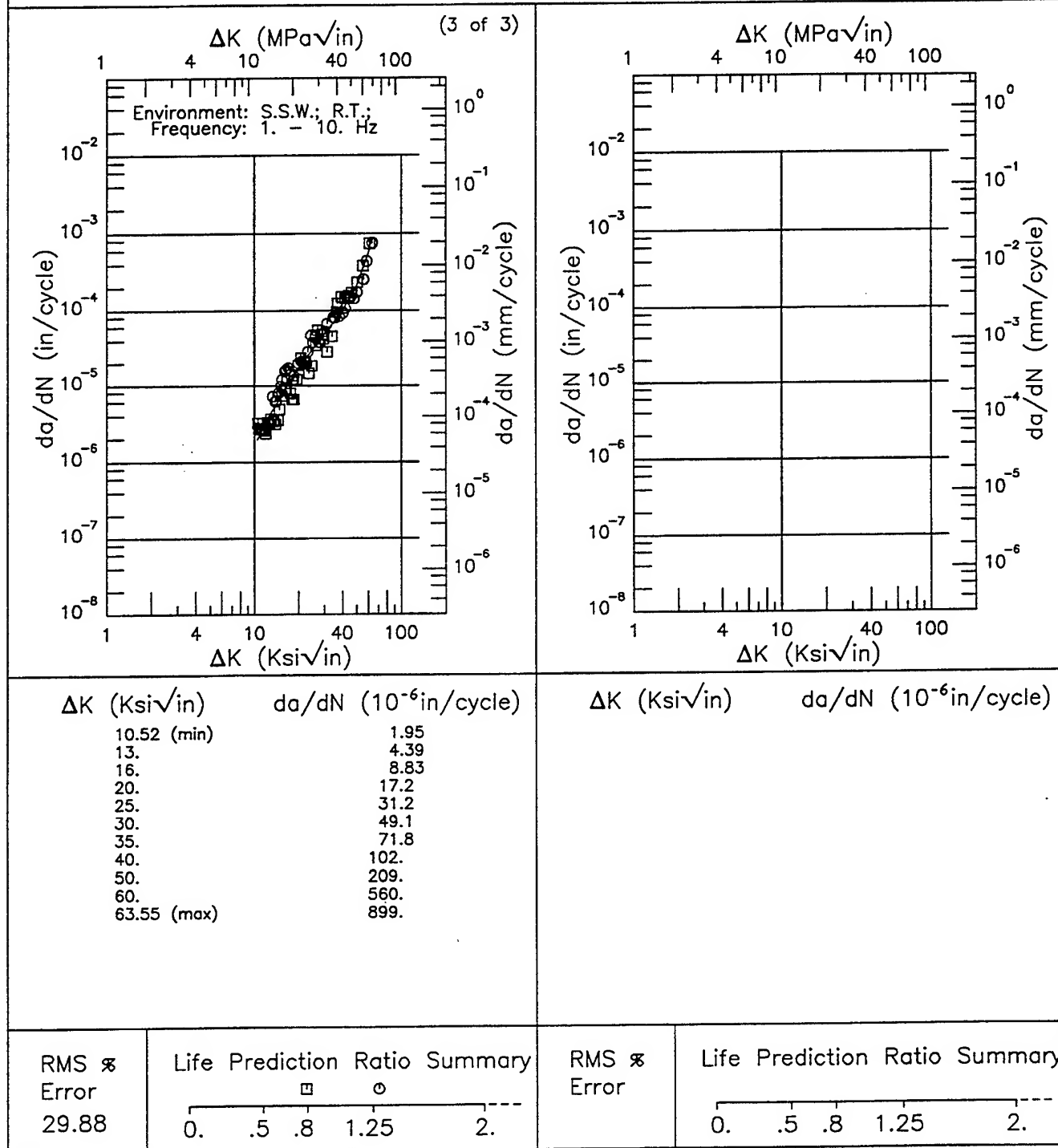


Figure 6.16.3.1.89 (Concluded)

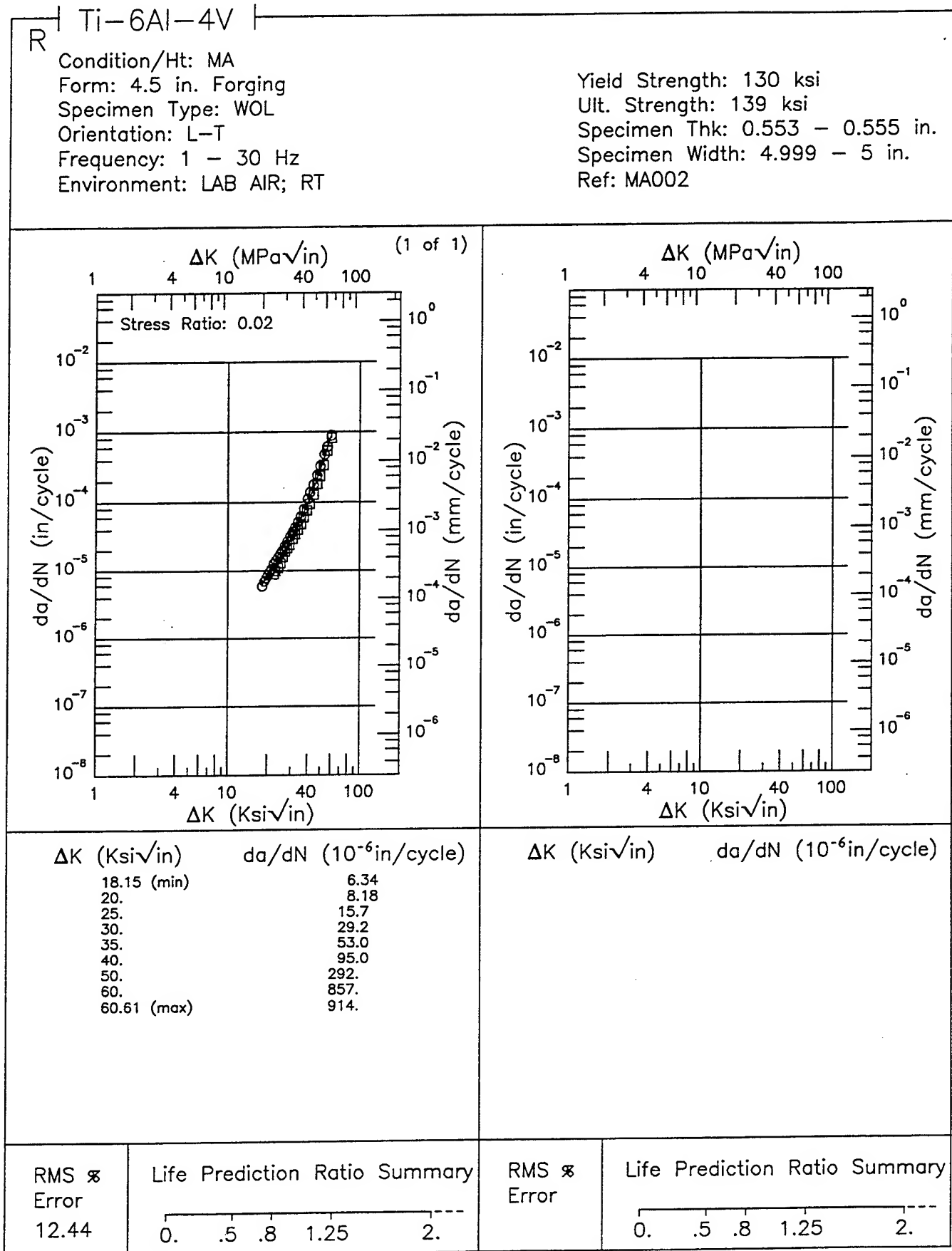


Figure 6.16.3.1.90

Condition/Ht: MA  
 Form: 2 in. Forging  
 Specimen Type: DCB  
 Orientation: L-T  
 Stress Ratio: 0.02  
 Frequency: 0.1 Hz

Yield Strength: 145 ksi  
 Ult. Strength: 156 ksi  
 Specimen Thk: 0.75 in.  
 Specimen Width: 5.5 in.  
 Ref: 84360

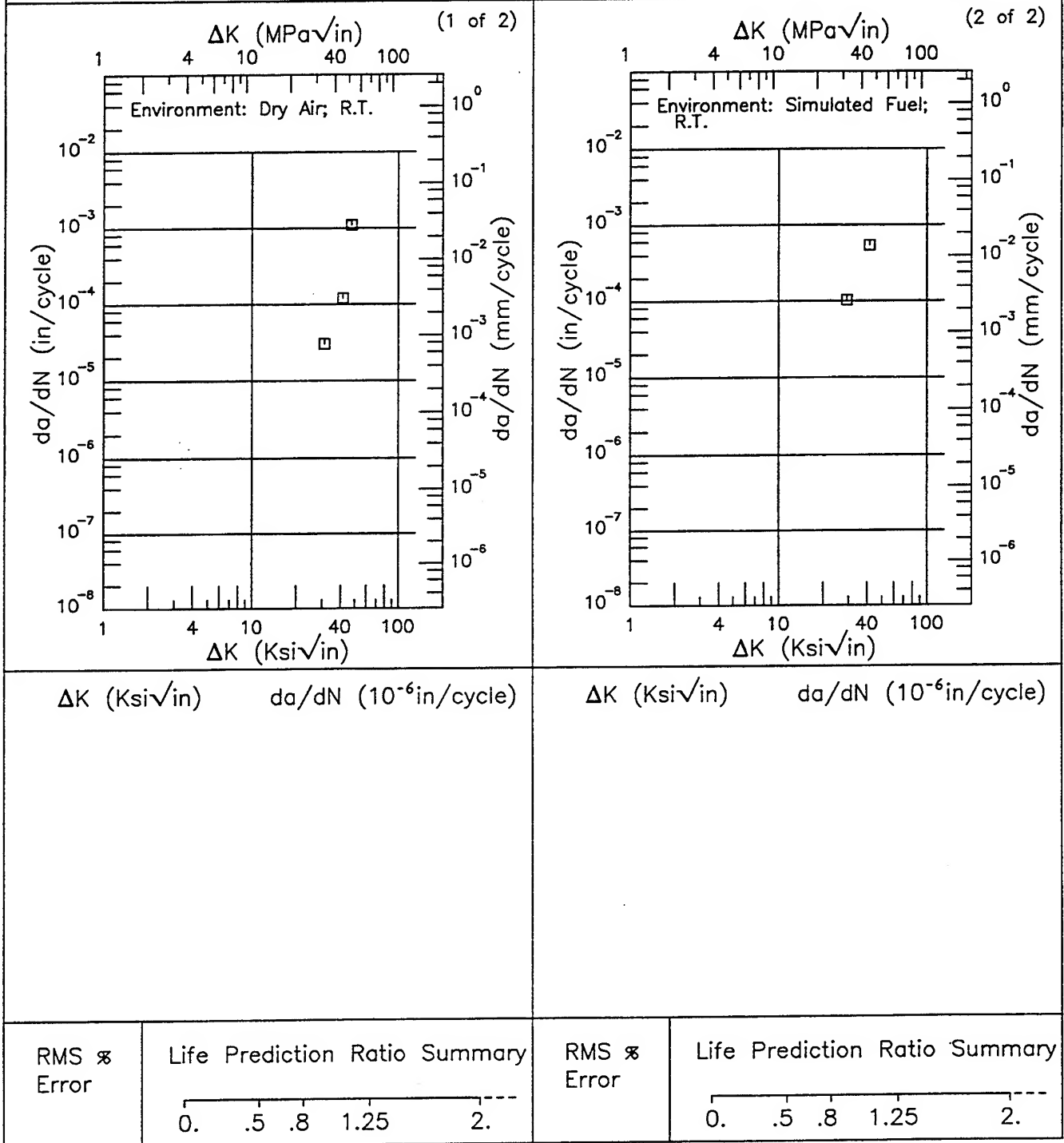


Figure 6.16.3.1.91

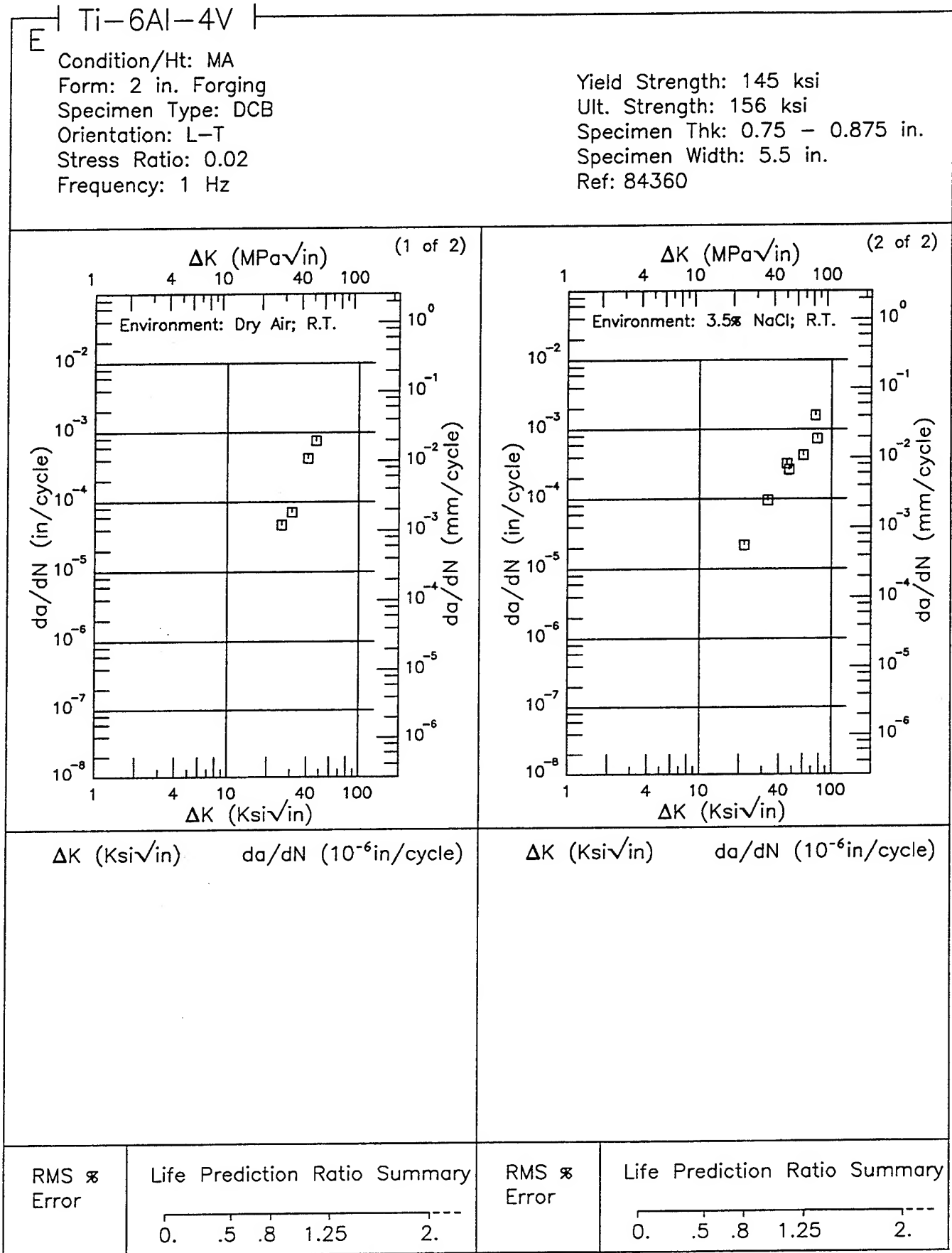


Figure 6.16.3.1.92

**This page intentionally left blank**

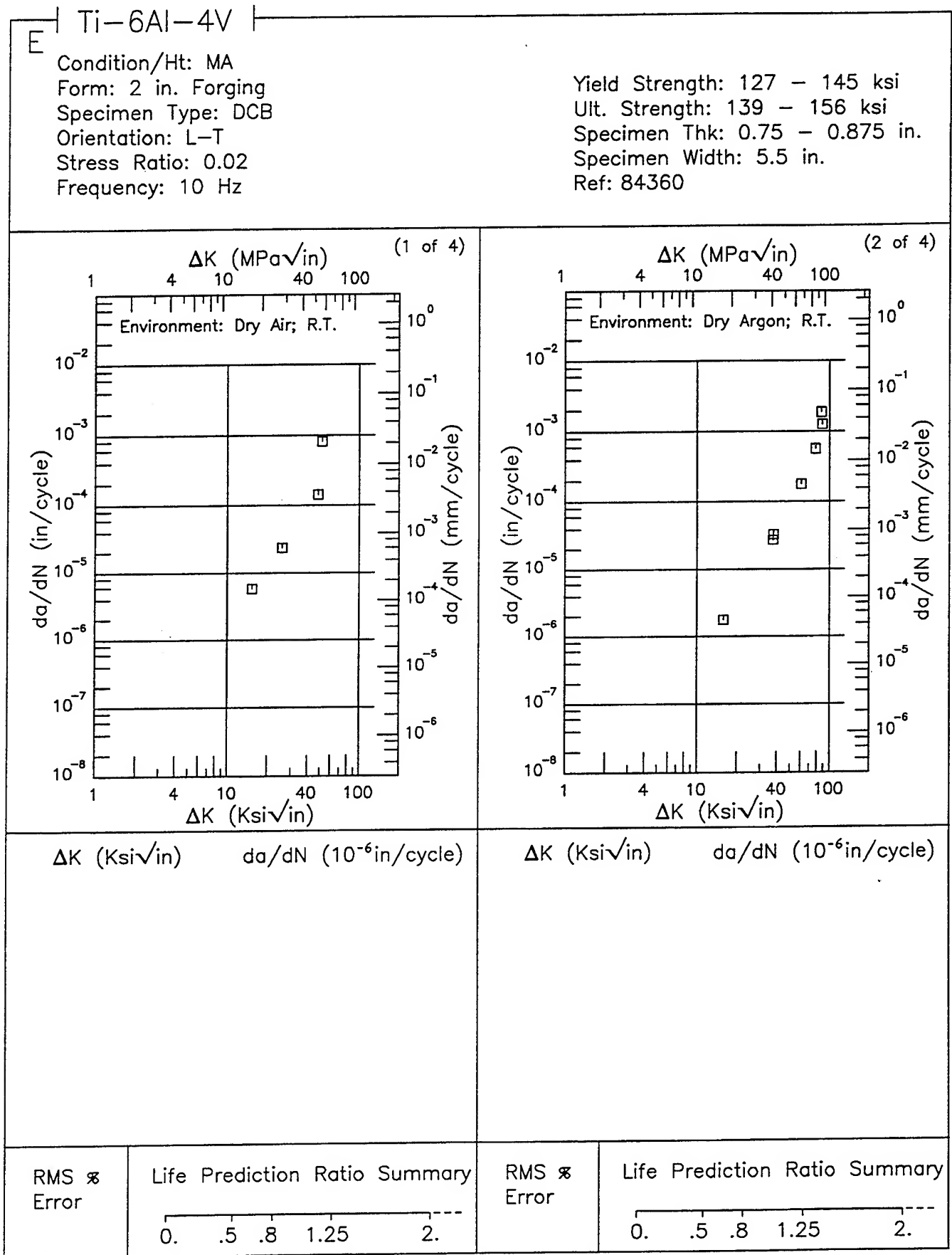


Figure 6.16.3.1.93

Condition/Ht: MA  
Form: 2 in. Forging  
Specimen Type: DCB  
Orientation: L-T  
Stress Ratio: 0.02  
Frequency: 10 Hz

Yield Strength: 127 - 145 ksi  
Ult. Strength: 139 - 156 ksi  
Specimen Thk: 0.75 - 0.875 in.  
Specimen Width: 5.5 in.  
Ref: 84360

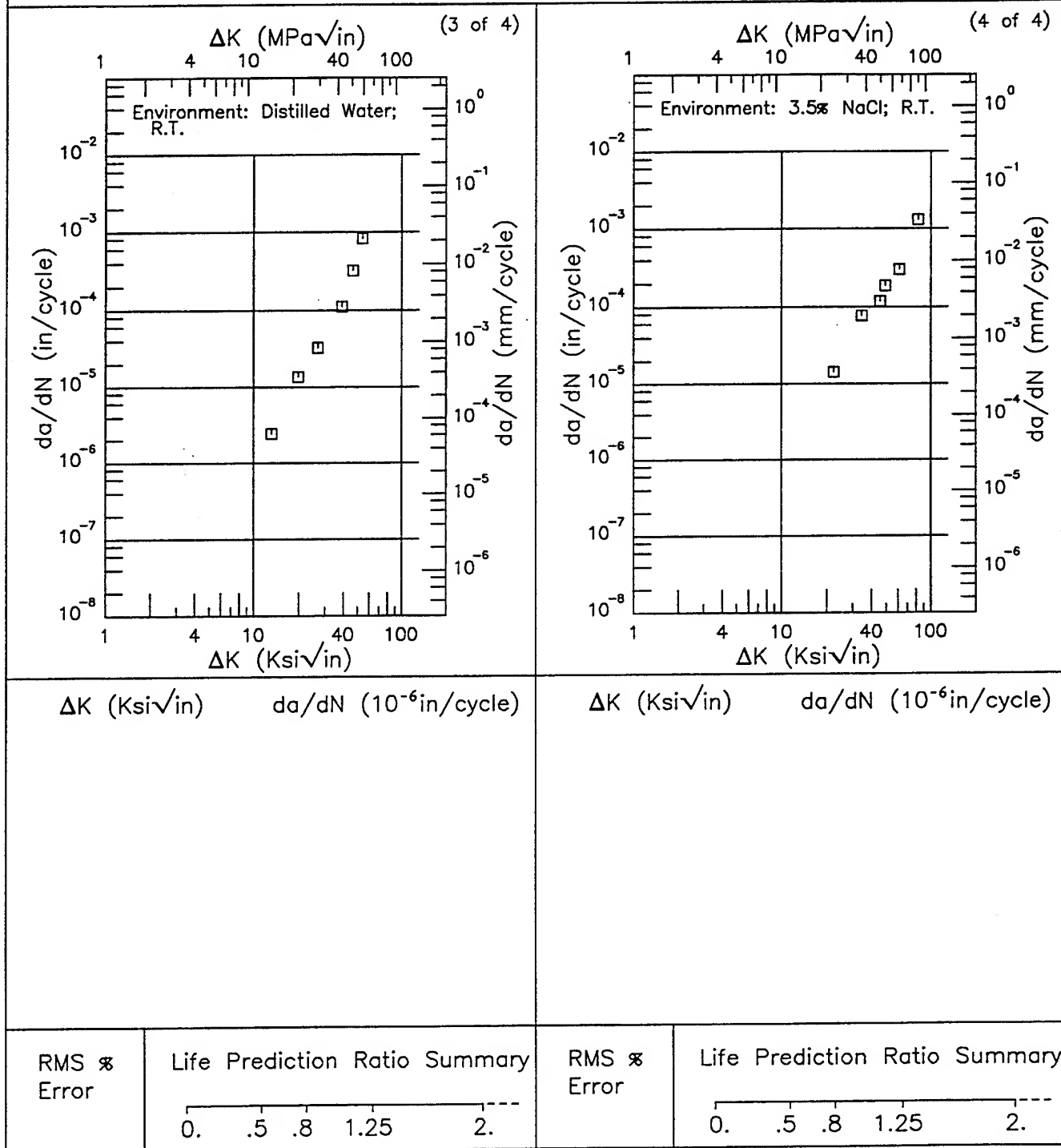
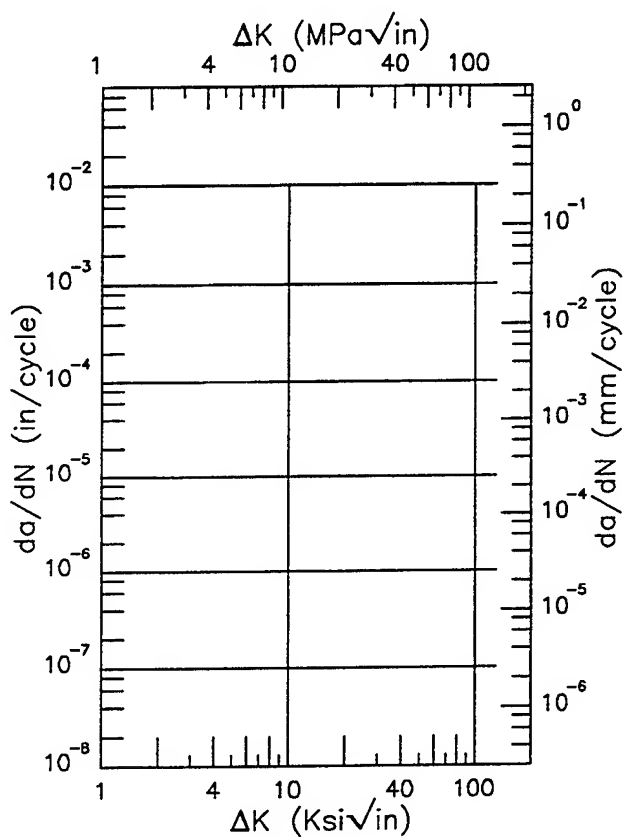
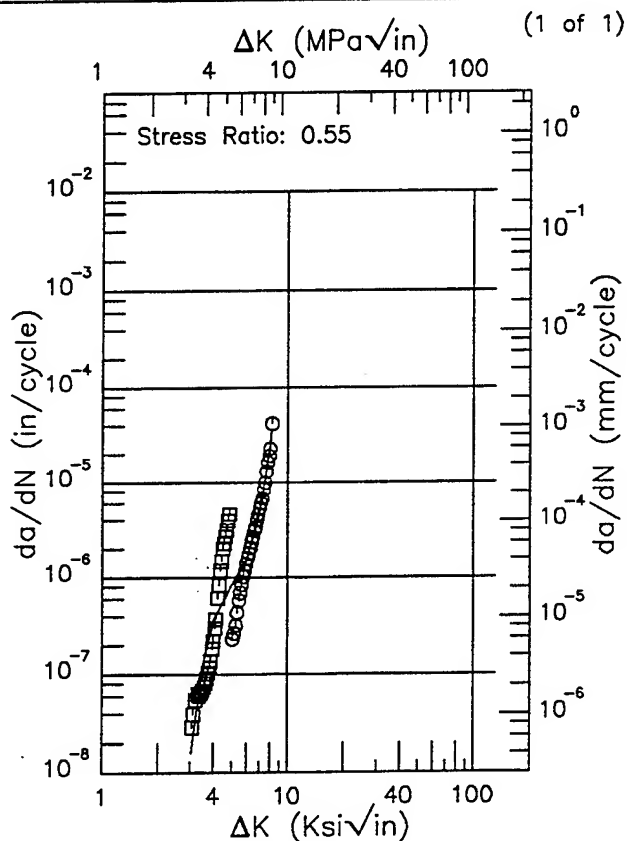


Figure 6.16.3.1.93 (Concluded)



R | Ti-6Al-4V |  
 Condition/Ht: MA  
 Form:  
 Specimen Type: CT  
 Orientation: L-T  
 Frequency: 10 Hz  
 Environment: LAB AIR; RT

Yield Strength:  
 Ult. Strength:  
 Specimen Thk: 0.25 - 0.251 in.  
 Specimen Width: 2 in.  
 Ref: NC005



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
3.06 (min)	0.0159
3.5	0.116
4.	0.356
5.	0.844
6.	1.56
7.	4.56
8.	25.7
8.17 (max)	36.6

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
--------------------------------------	-------------------------------

RMS %  
 Error  
 >100.0

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

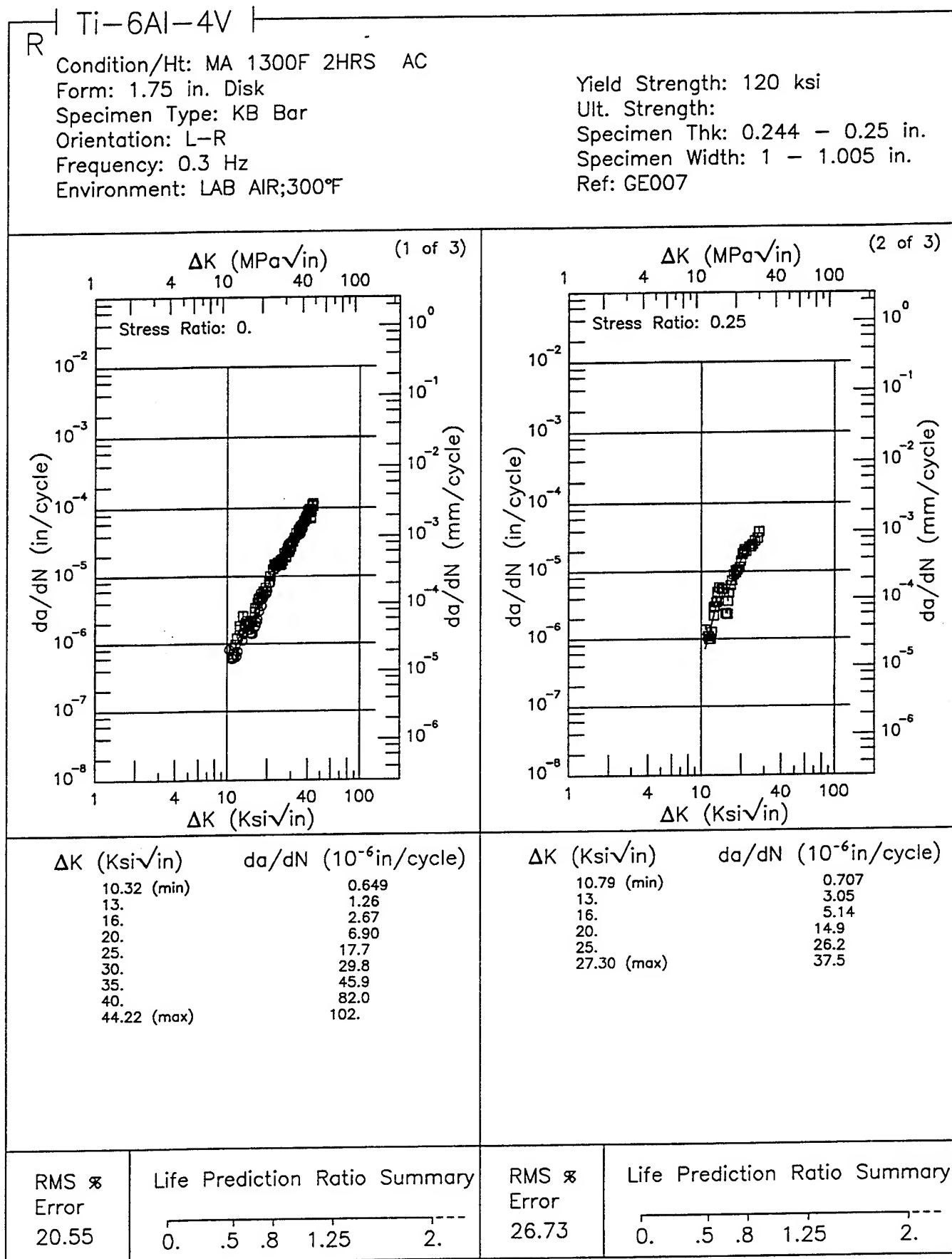
RMS %  
 Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 6.16.3.1.94

**This page intentionally left blank**



**Figure 6.16.3.1.95**

Ti-6Al-4V

R

Condition/Ht: MA 1300F 2HRS AC

Form: 1.75 in. Disk

Specimen Type: KB Bar

Orientation: L-R

Frequency: 0.3 Hz

Environment: LAB AIR;300°F

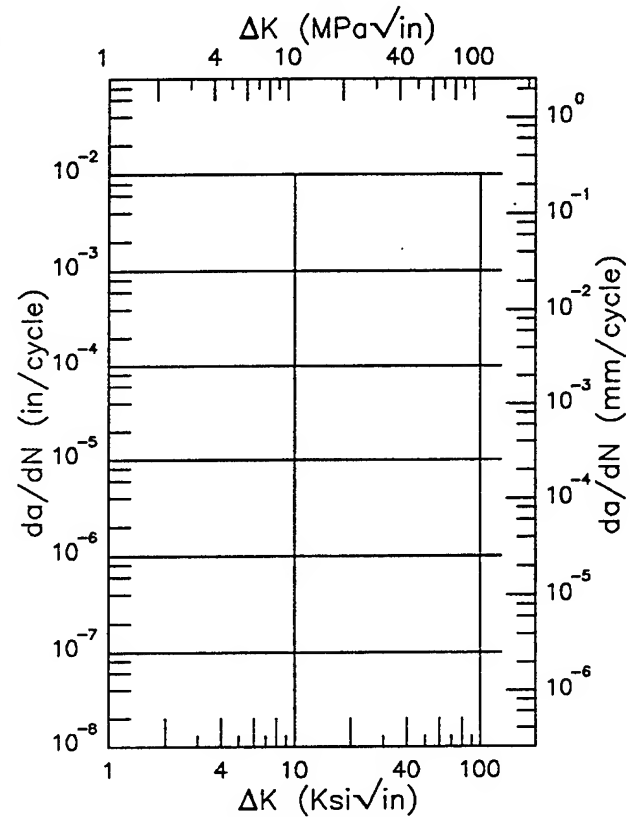
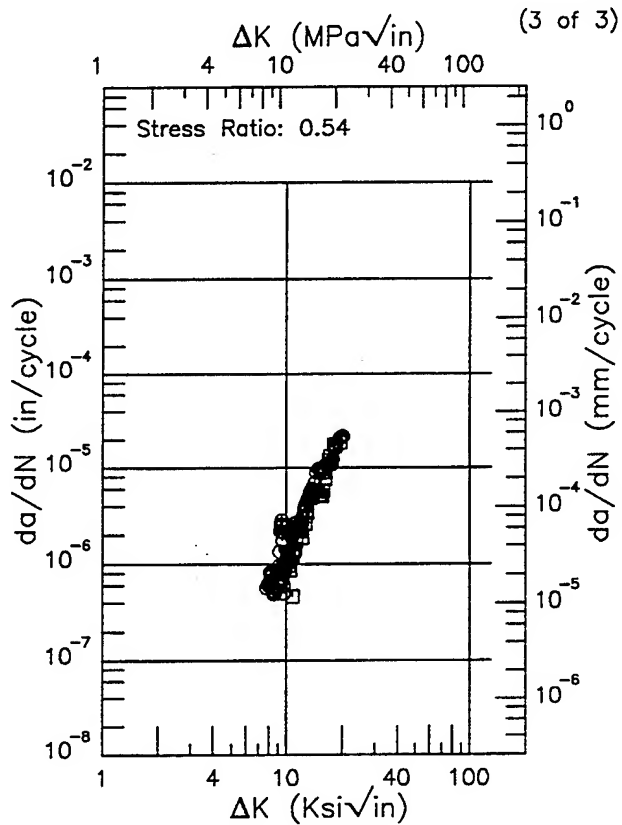
Yield Strength: 120 ksi

Ult. Strength:

Specimen Thk: 0.244 - 0.25 in.

Specimen Width: 1 - 1.005 in.

Ref: GE007



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
7.74 (min)	0.526
8.	0.612
9.	0.868
10.	1.12
13.	4.23
16.	8.63
19.93 (max)	20.0

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
--------------------------------------	-----------------------------------

RMS  $\times$   
Error  
43.65

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS  $\times$   
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.16.3.1.95 (Concluded)

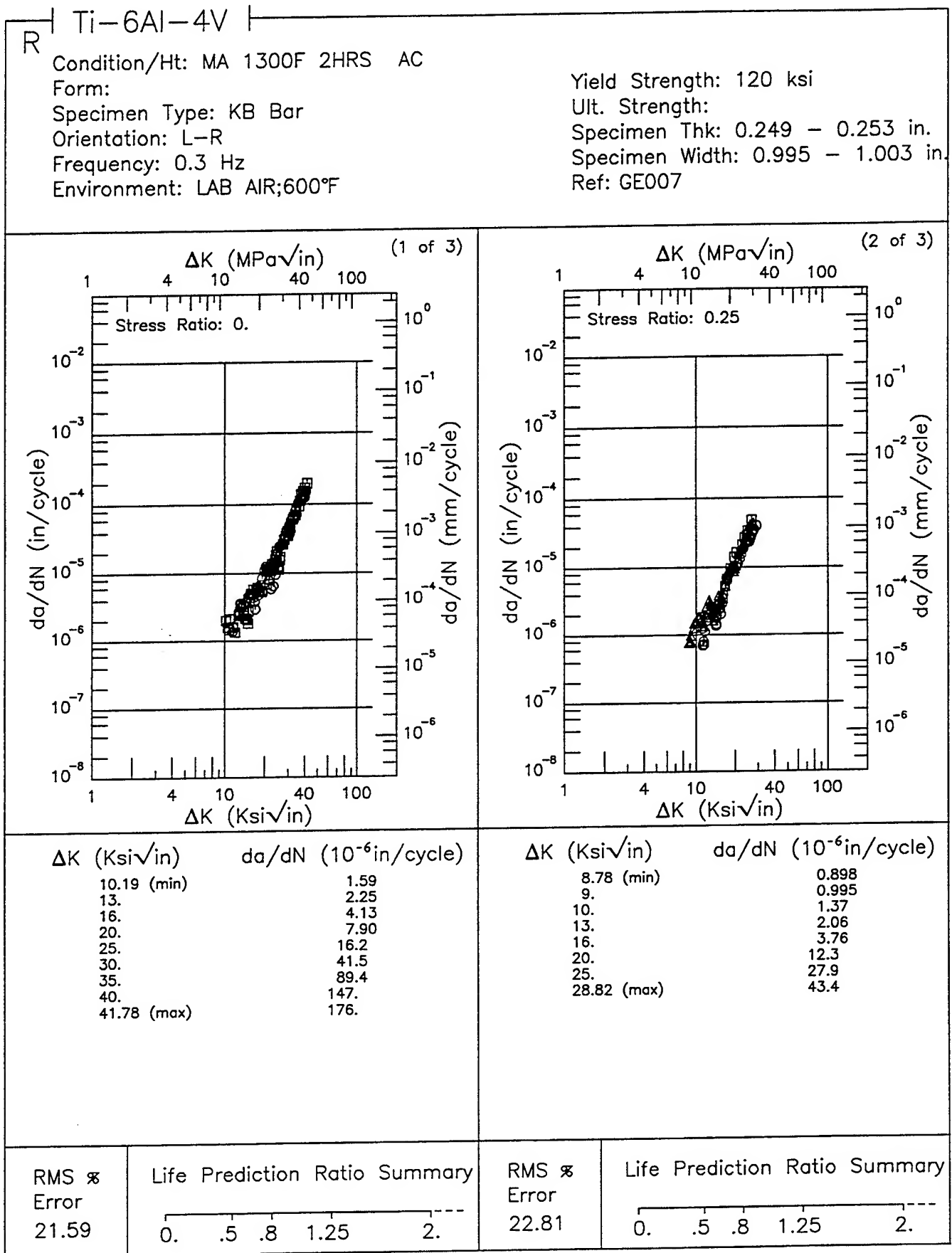


Figure 6.16.3.1.96

Ti-6Al-4V R

Condition/Ht: MA 1300F 2HRS AC  
 Form:  
 Specimen Type: KB Bar  
 Orientation: L-R  
 Frequency: 0.3 Hz  
 Environment: LAB AIR;600°F

Yield Strength: 120 ksi  
 Ult. Strength:  
 Specimen Thk: 0.249 - 0.253 in.  
 Specimen Width: 0.995 - 1.003 in.  
 Ref: GE007

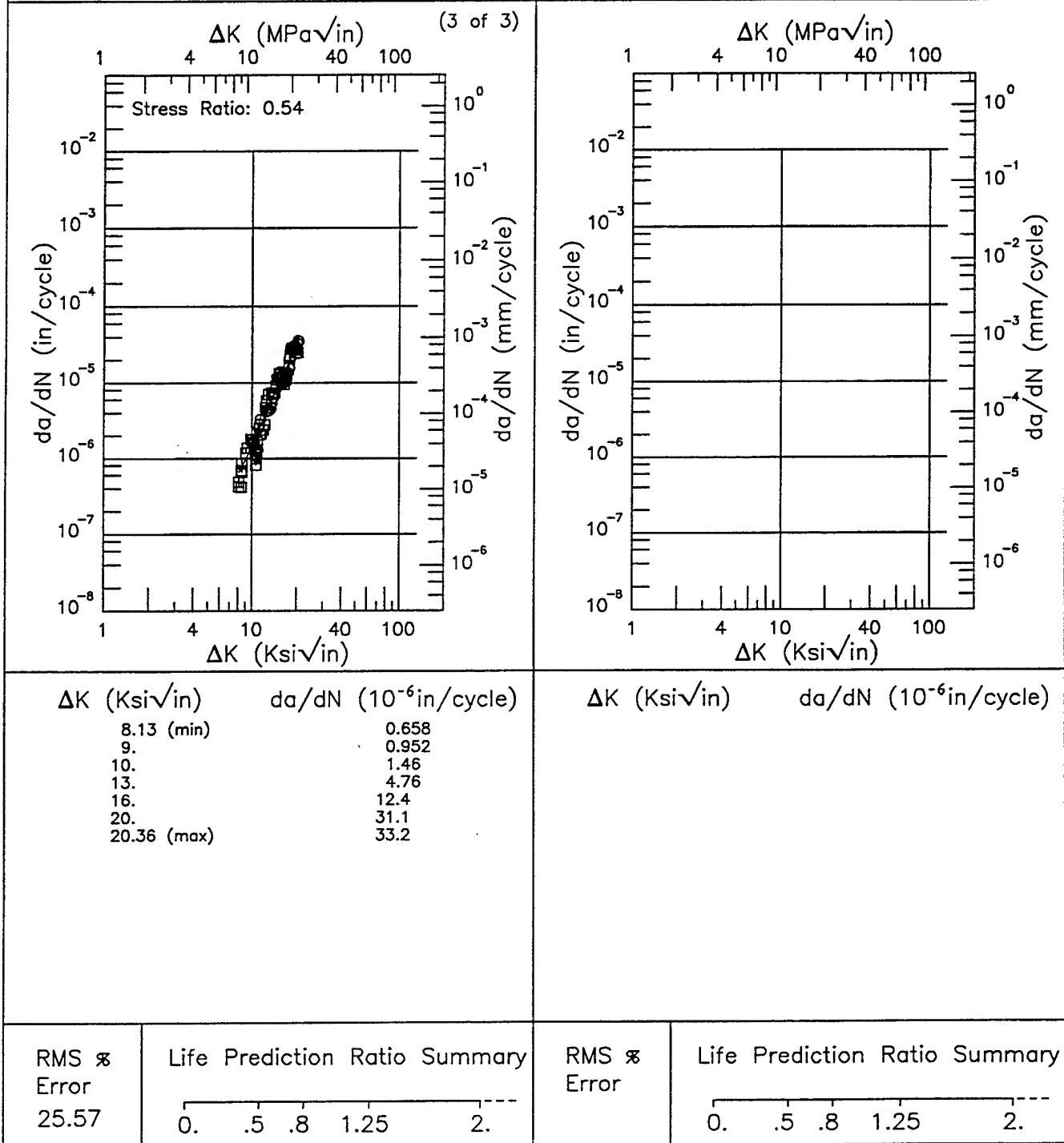
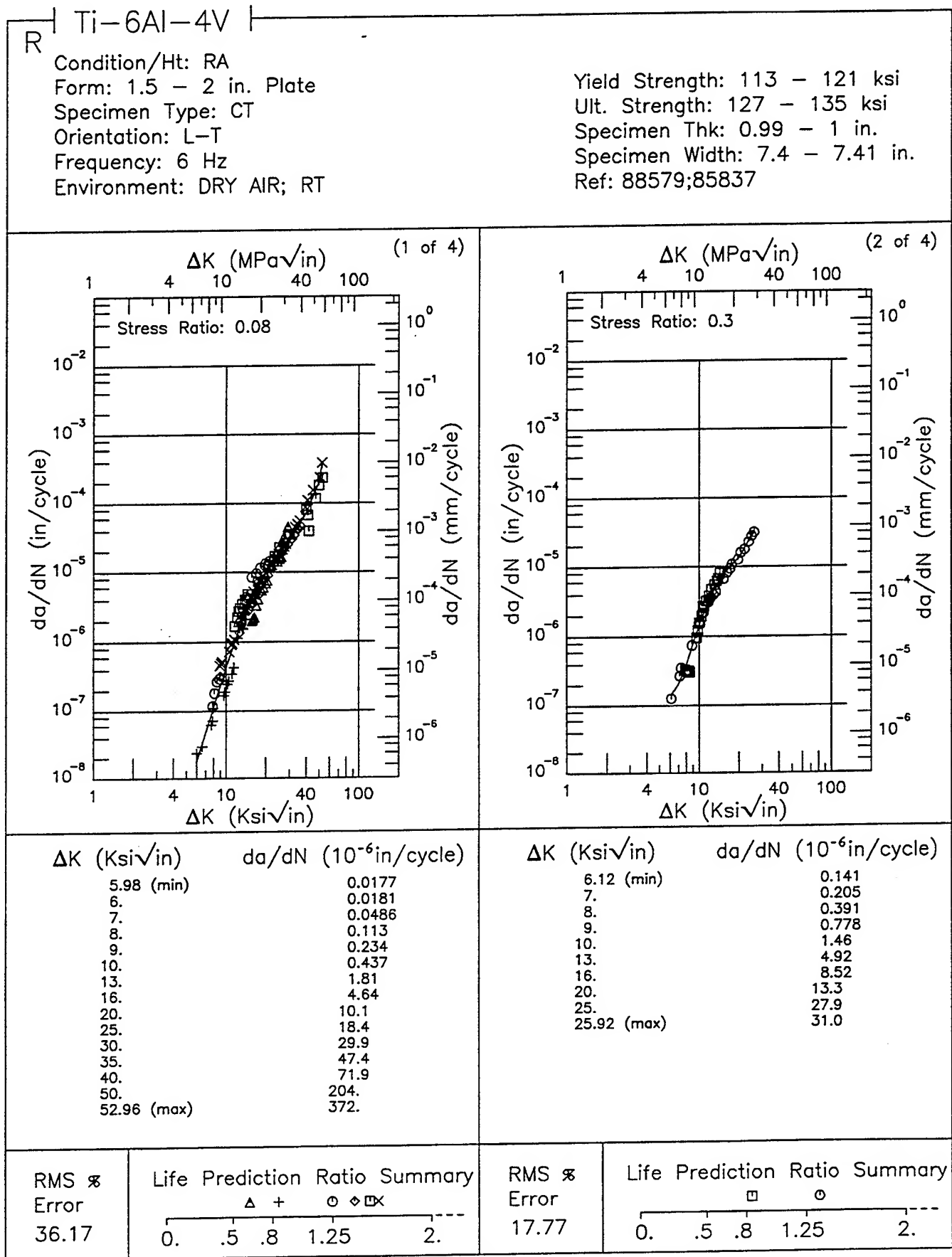


Figure 6.16.3.1.96 (Concluded)



**Figure 6.16.3.1.97**

Condition/Ht: RA  
Form: 1.5 - 2 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Frequency: 6 Hz  
Environment: DRY AIR; RT

Yield Strength: 113 - 121 ksi  
Ult. Strength: 127 - 135 ksi  
Specimen Thk: 0.99 - 1 in.  
Specimen Width: 7.4 - 7.41 in.  
Ref: 88579;85837

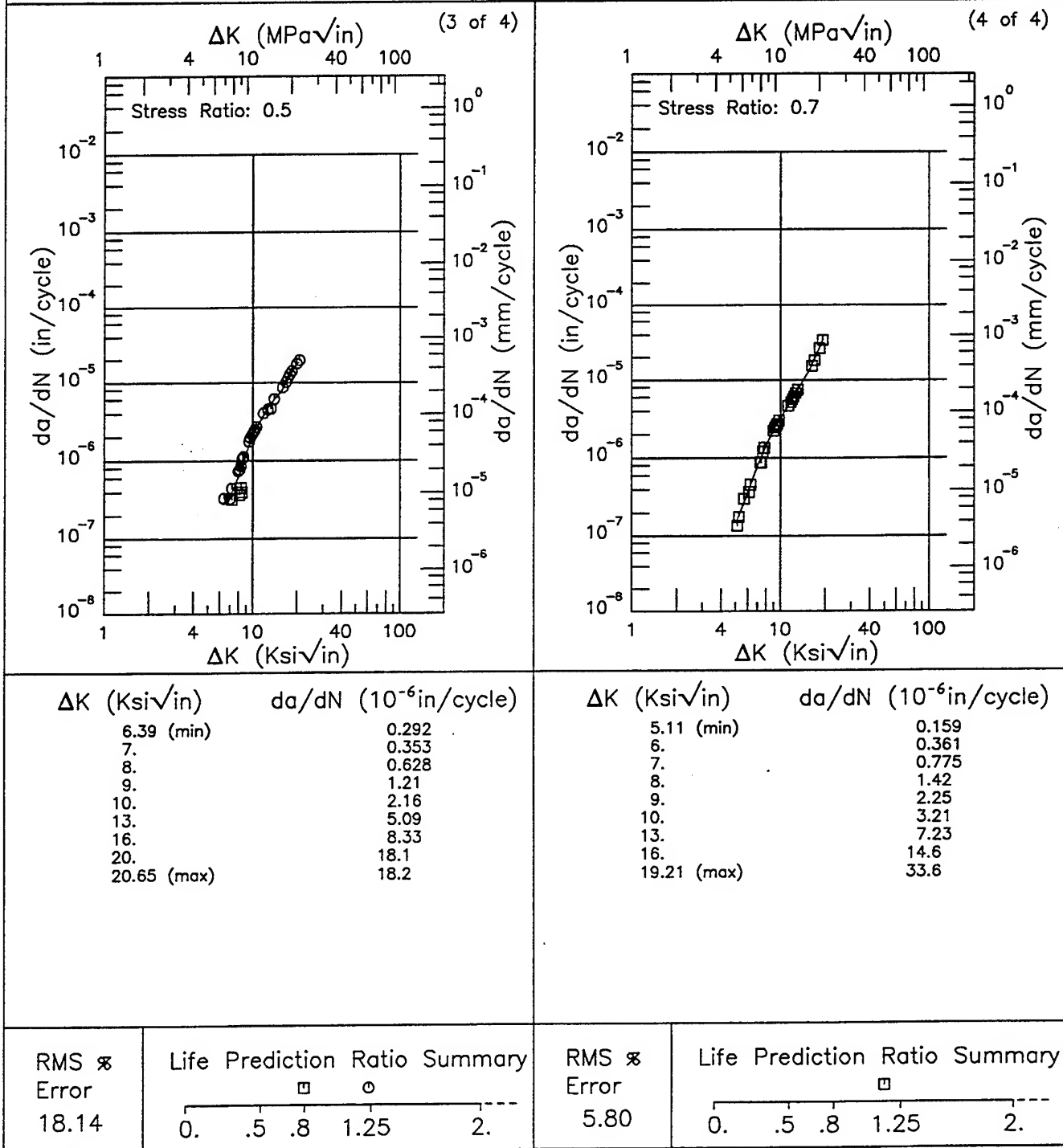


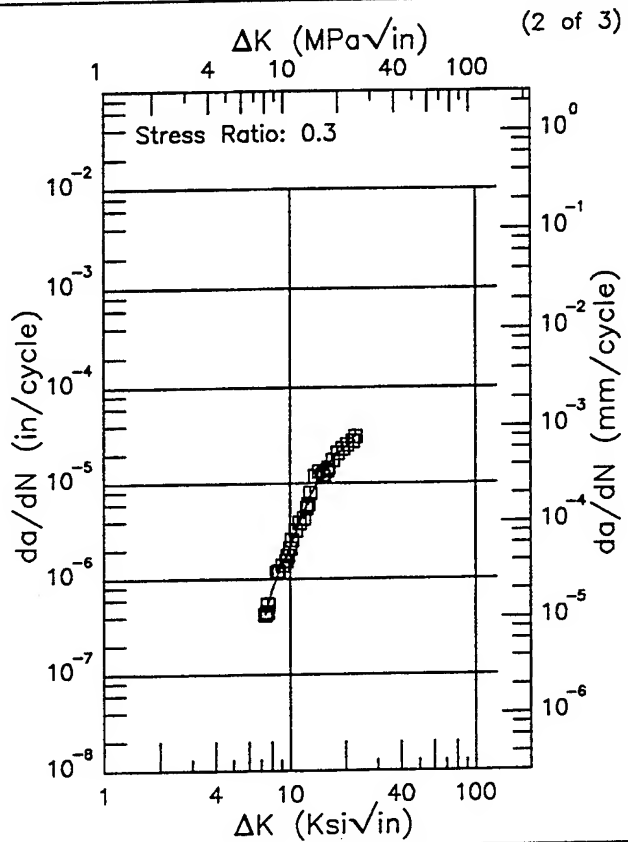
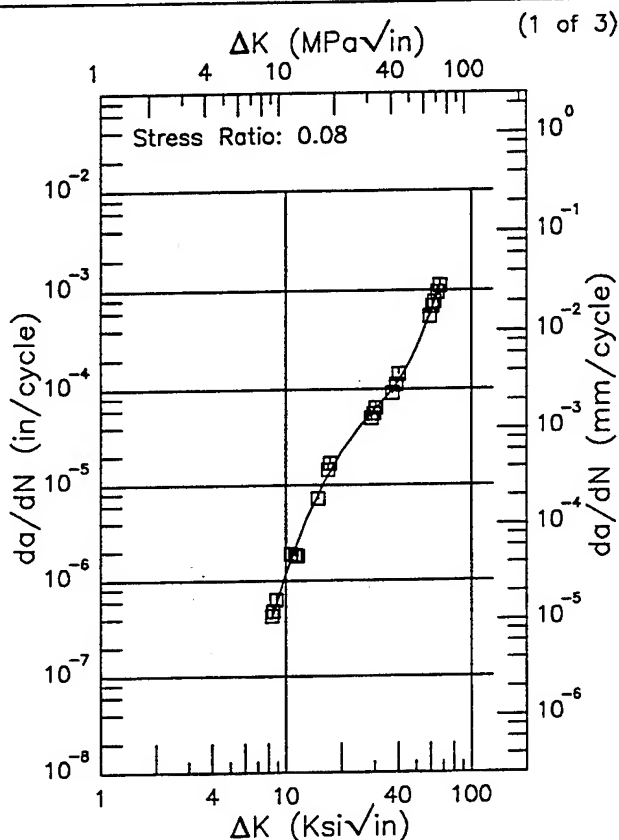
Figure 6.16.3.1.97 (Concluded)



R | Ti-6Al-4V |

Condition/Ht: RA  
Form: 1.5 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Frequency: 1 Hz  
Environment: S.T.W.; RT

Yield Strength: 118 ksi  
Ult. Strength: 129 ksi  
Specimen Thk: 0.995 - 0.998 in.  
Specimen Width: 7.4 in.  
Ref: 85837



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.35 (min)	0.400
9.	0.642
10.	1.19
13.	4.49
16.	10.5
20.	22.4
25.	41.2
30.	62.1
35.	86.2
40.	119.
50.	255.
60.	602.
66.77 (max)	1055.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
7.37 (min)	0.434
8.	0.754
9.	1.39
10.	2.20
13.	7.72
16.	15.5
20.	24.1
22.54 (max)	27.8

RMS %  
Error  
11.85

Life Prediction Ratio Summary  
□  
0. .5 .8 1.25 2.

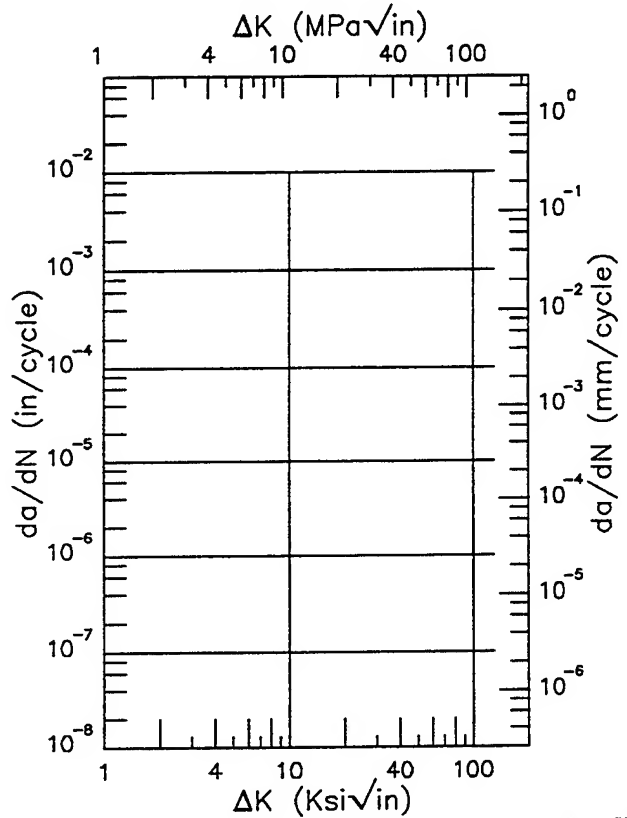
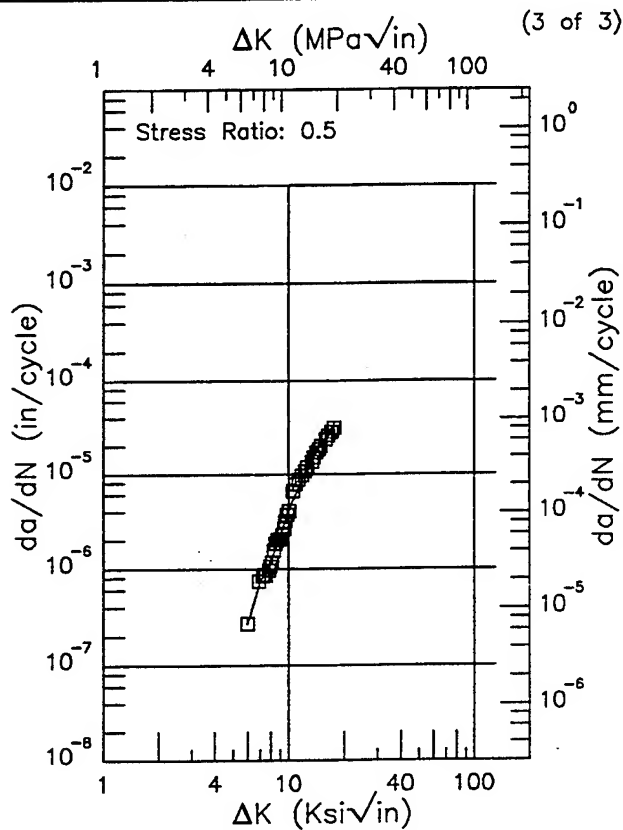
RMS %  
Error  
10.05

Life Prediction Ratio Summary  
□  
0. .5 .8 1.25 2.

Figure 6.16.3.1.98

Condition/Ht: RA  
Form: 1.5 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Frequency: 1 Hz  
Environment: S.T.W.; RT

Yield Strength: 118 ksi  
Ult. Strength: 129 ksi  
Specimen Thk: 0.995 - 0.998 in.  
Specimen Width: 7.4 in.  
Ref: 85837



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
5.97 (min)	0.272
6.	0.284
7.	0.731
8.	1.24
9.	2.14
10.	4.18
13.	13.6
16.	24.8
17.45 (max)	29.3

ΔK (Ksi√in) da/dN (10<sup>-6</sup>in/cycle)

RMS %  
Error  
10.63

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
Error

Life Prediction Ratio Summary

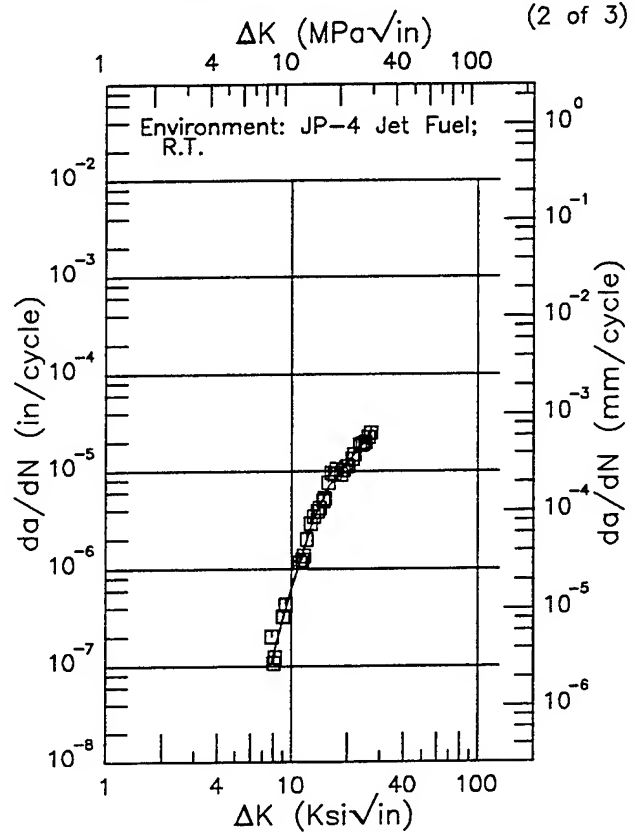
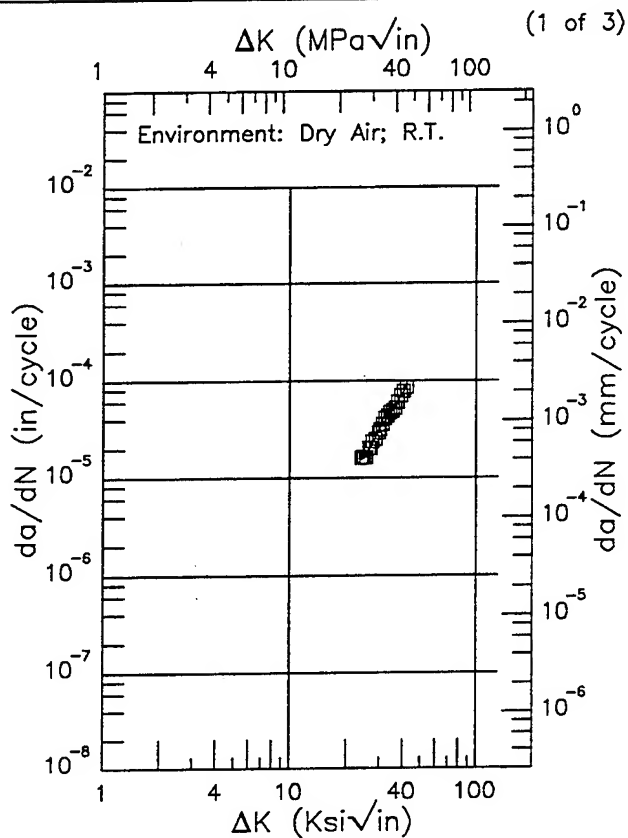
0. .5 .8 1.25 2.

Figure 6.16.3.1.98 (Concluded)

E | Ti-6Al-4V |

Condition/Ht: RA  
Form: 1.5 - 2.5 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.08  
Frequency: 1 Hz

Yield Strength: 118 - 124 ksi  
Ult. Strength: 129 - 138 ksi  
Specimen Thk: 0.99 - 1 in.  
Specimen Width: 7.4 in.  
Ref: 85837;88579



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
24.00 (min)	15.5
25.	16.5
30.	31.7
35.	49.2
40.	75.1
41.69 (max)	86.7

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
7.83 (min)	0.111
8.	0.130
9.	0.306
10.	0.637
13.	3.06
16.	7.07
20.	12.4
25.	20.4
26.71 (max)	25.2

RMS %  
Error  
3.31

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

RMS %  
Error  
17.85

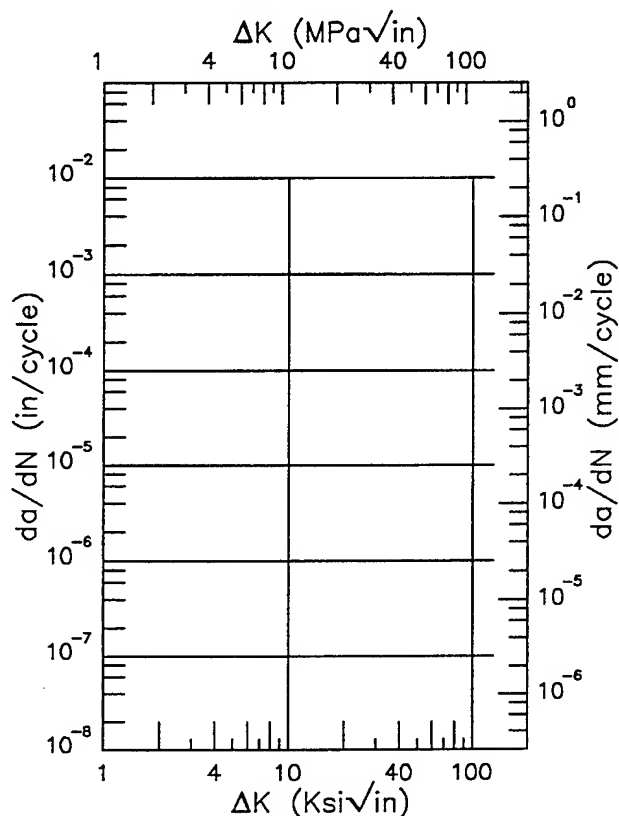
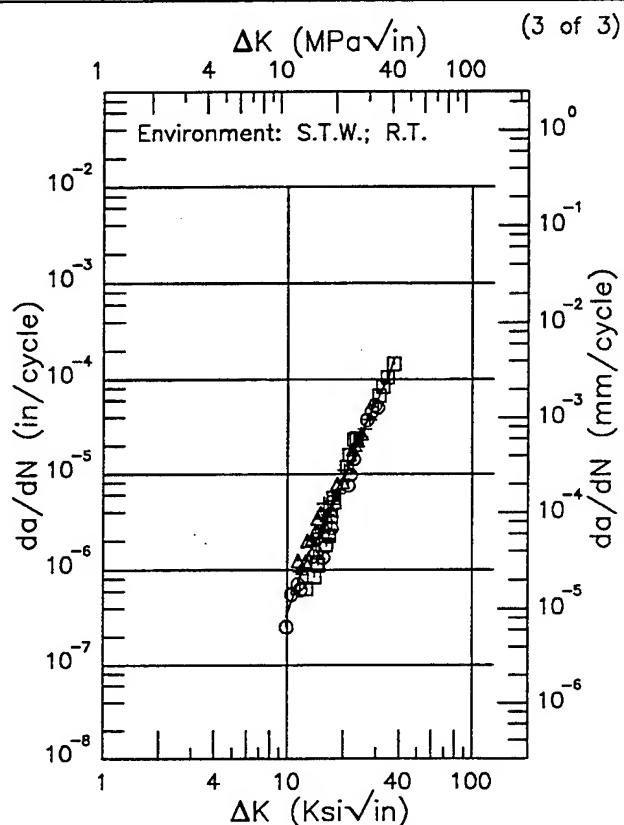
Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

Figure 6.16.3.1.99

Condition/Ht: RA  
 Form: 1.5 - 2.5 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.08  
 Frequency: 1 Hz

Yield Strength: 118 - 124 ksi  
 Ult. Strength: 129 - 138 ksi  
 Specimen Thk: 0.99 - 1 in.  
 Specimen Width: 7.39 - 7.4 in.  
 Ref: 85837;88579



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
9.87 (min)	0.328
10.	0.359
13.	1.40
16.	3.08
20.	8.22
25.	27.1
30.	57.3
35.	106.
37.05 (max)	153.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
--------------------------------------	-----------------------------------

RMS %  
 Error  
 29.82

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
 Error

Life Prediction Ratio Summary

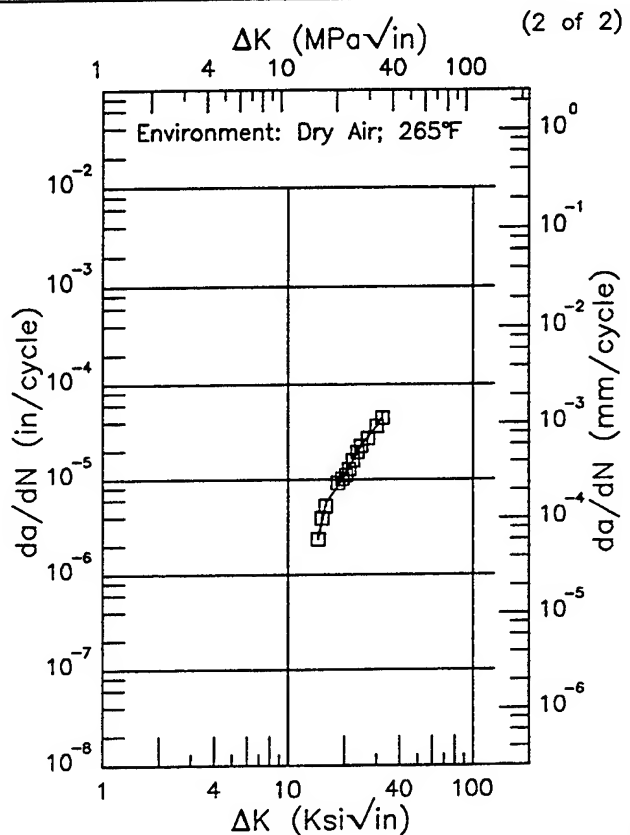
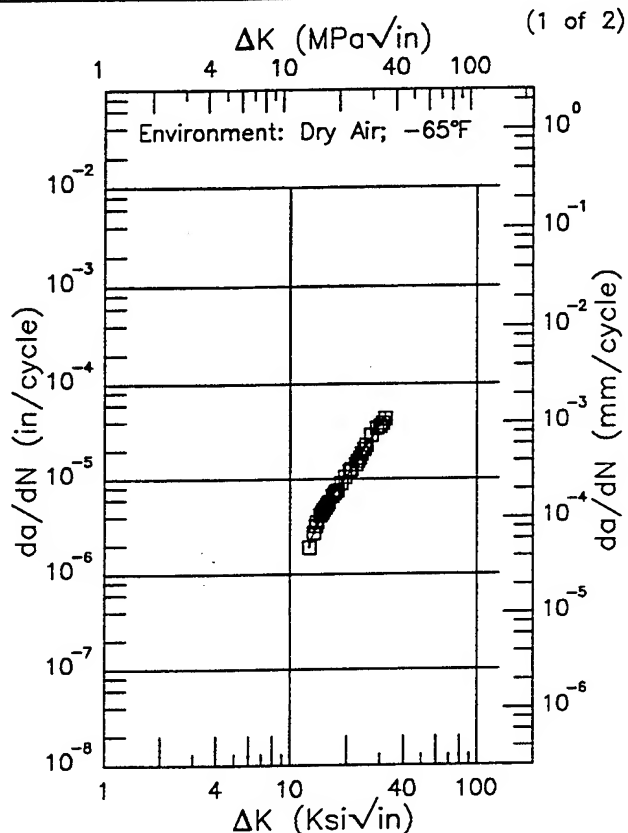
0. .5 .8 1.25 2.---

Figure 6.16.3.1.99 (Concluded)

Ti-6Al-4V

Condition/Ht: RA  
Form: 1.5 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.08  
Frequency: 6 Hz

Yield Strength: 118 - 121 ksi  
Ult. Strength: 129 - 134 ksi  
Specimen Thk: 0.99 - 0.997 in.  
Specimen Width: 5 - 7.4 in.  
Ref: 85837;88579



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.57 (min)	1.93
13.	2.37
16.	5.81
20.	10.5
25.	21.4
30.	36.8
31.93 (max)	40.2

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
14.47 (min)	2.44
16.	5.63
20.	10.8
25.	23.1
30.	35.8
32.07 (max)	44.6

RMS %  
Error  
4.97

Life Prediction Ratio Summary  
0. .5 .8 1.25 2.

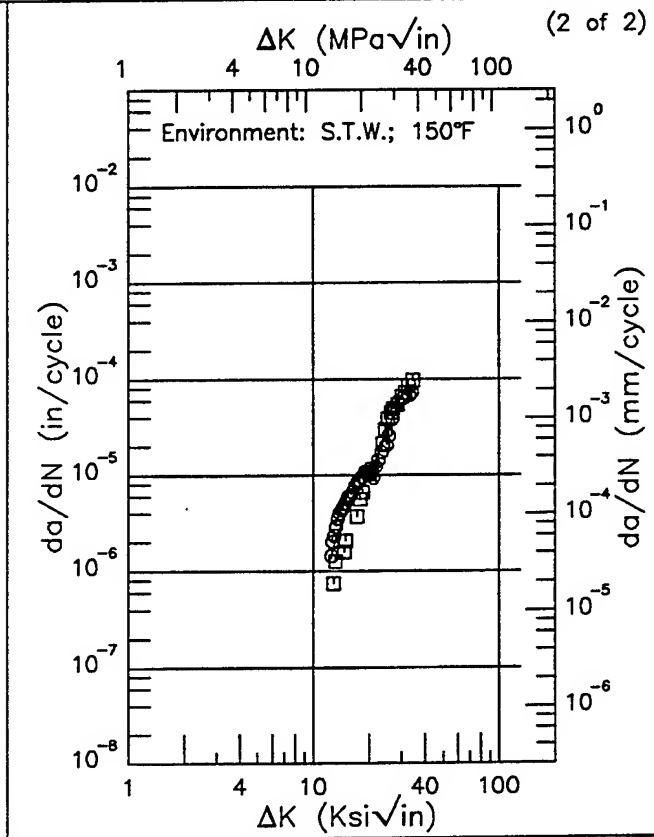
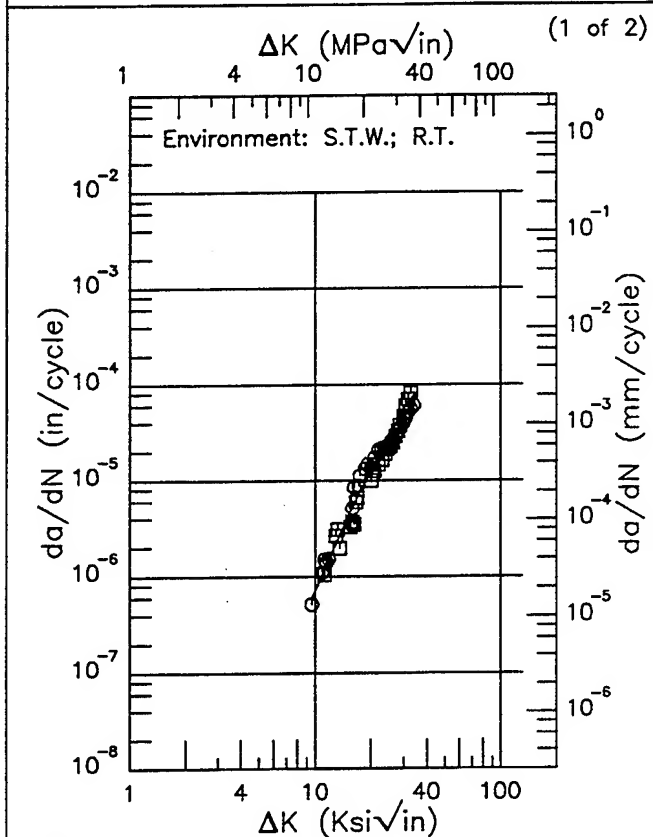
RMS %  
Error  
4.42

Life Prediction Ratio Summary  
0. .5 .8 1.25 2.

Figure 6.16.3.1.100

Condition/Ht: RA  
Form: 1.5 - 2 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.08  
Frequency: 0.1 - 1 Hz

Yield Strength: 117 - 122 ksi  
Ult. Strength: 133 - 135 ksi  
Specimen Thk: 0.988 - 1.01 in.  
Specimen Width: 7.39 - 7.4 in.  
Ref: 88579;85837



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
9.52 (min)	0.585
10.	0.707
13.	2.18
16.	5.44
20.	12.9
25.	24.3
30.	43.0
33.81 (max)	76.9

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.49 (min)	1.35
13.	1.93
16.	5.61
20.	9.73
25.	28.1
30.	66.3
34.28 (max)	85.2

RMS %  
Error  
20.11

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

RMS %  
Error  
26.14

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

Figure 6.16.3.1.101

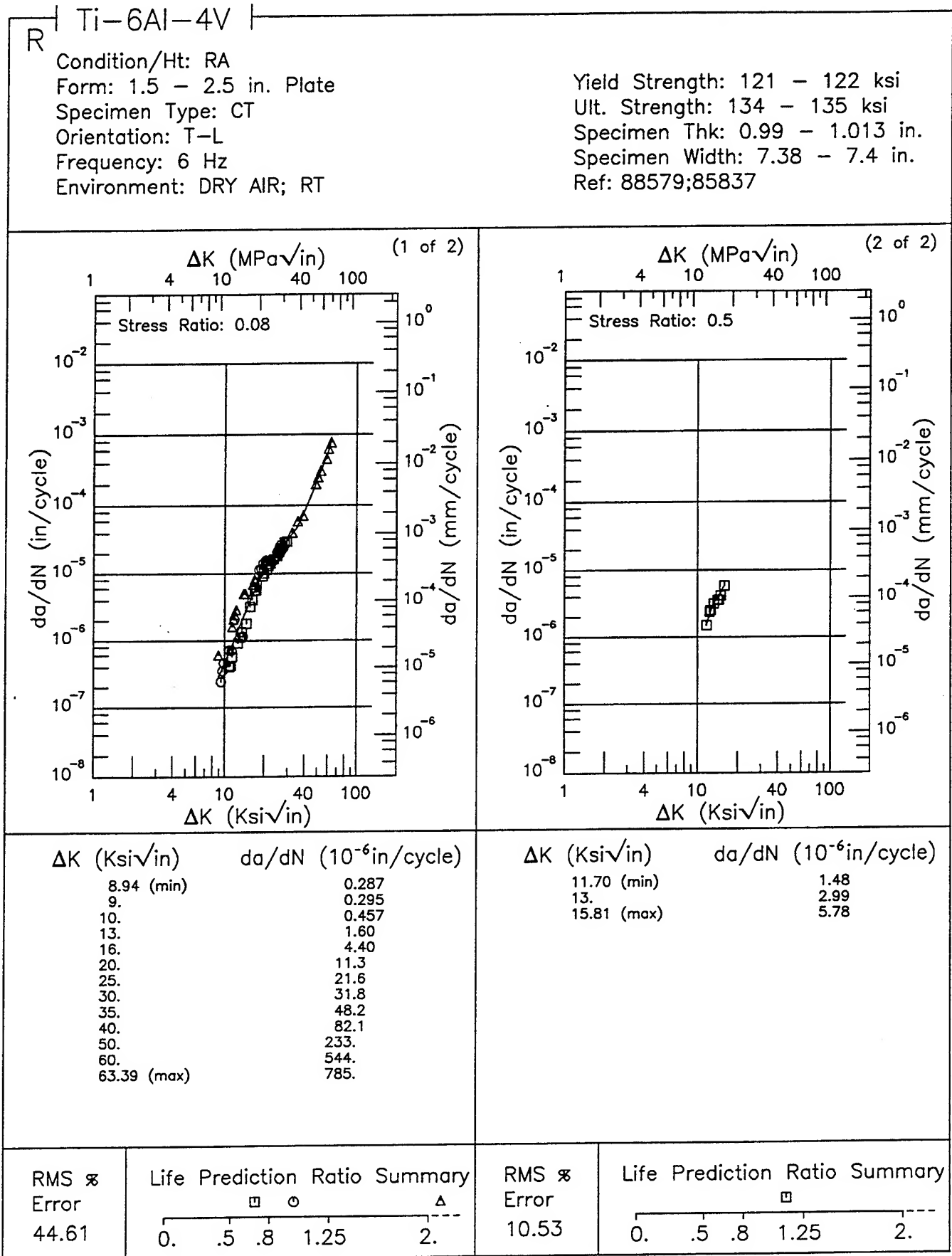


Figure 6.16.3.1.102

Condition/Ht: RA  
 Form: 1.5 - 2.5 in. Plate  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.08  
 Frequency: 1 Hz

Yield Strength: 122 - 126 ksi  
 Ult. Strength: 134 - 135 ksi  
 Specimen Thk: 0.994 - 1 in.  
 Specimen Width: 7.4 in.  
 Ref: 85837;88579

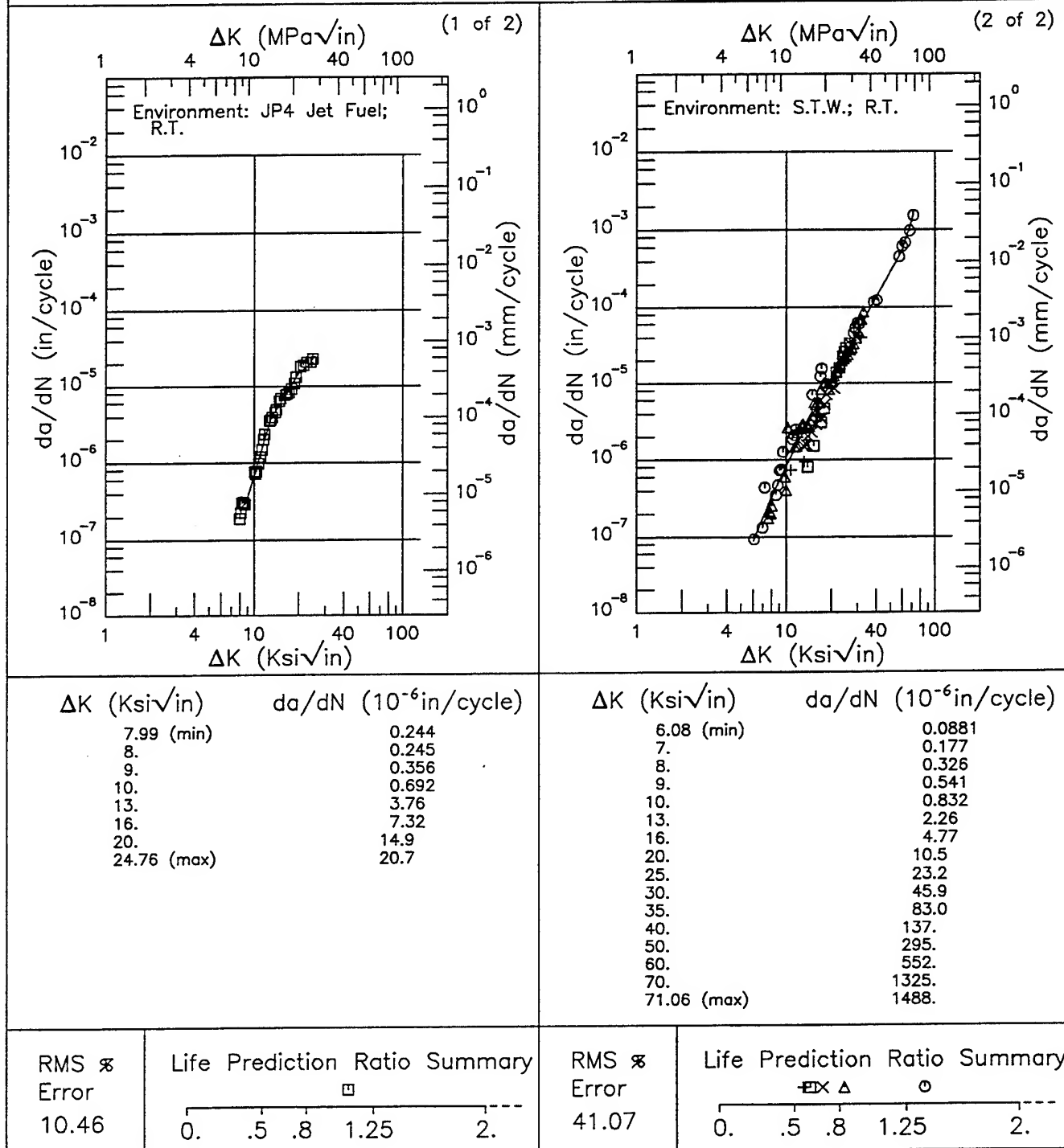


Figure 6.16.3.1.103



EF

Ti-6Al-4V

Condition/Ht: RA

Form: 0.38 - 1.5 in. Plate

Specimen Type: CT

Orientation: T-L

Stress Ratio: 0.08

Yield Strength: 125 - 129 ksi

Ult. Strength: 135 - 140 ksi

Specimen Thk: 0.41 - 0.501 in.

Specimen Width: 7.4 in.

Ref: 85837;88579

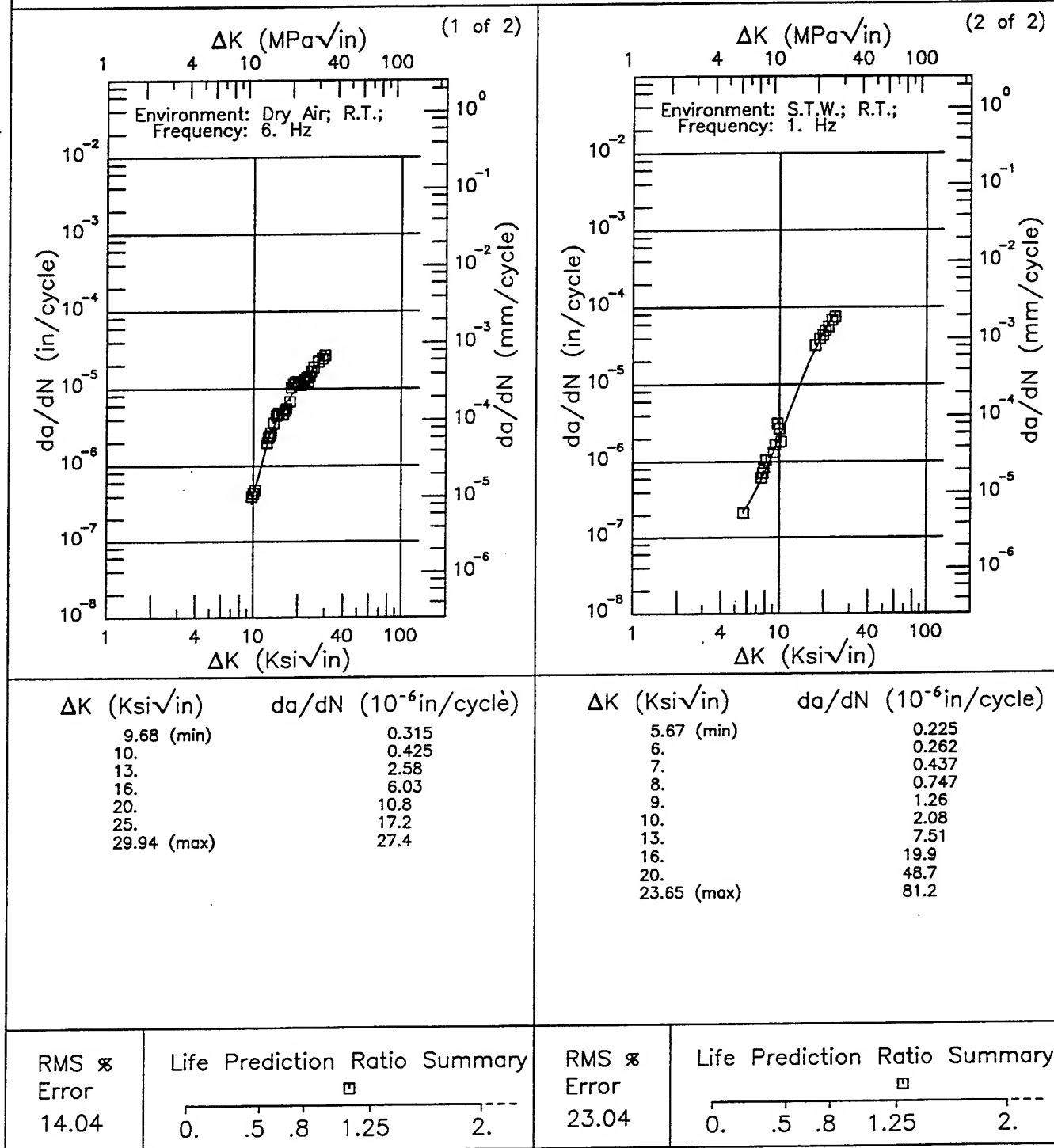


Figure 6.16.3.1.104

Condition/Ht: RA  
Form: 1.5 in. Plate  
Specimen Type: CT  
Orientation: T-L  
Stress Ratio: 0.08

Yield Strength: 117 ksi  
Ult. Strength: 133 ksi  
Specimen Thk: 1.38 in.  
Specimen Width: 4 in.  
Ref: 88579

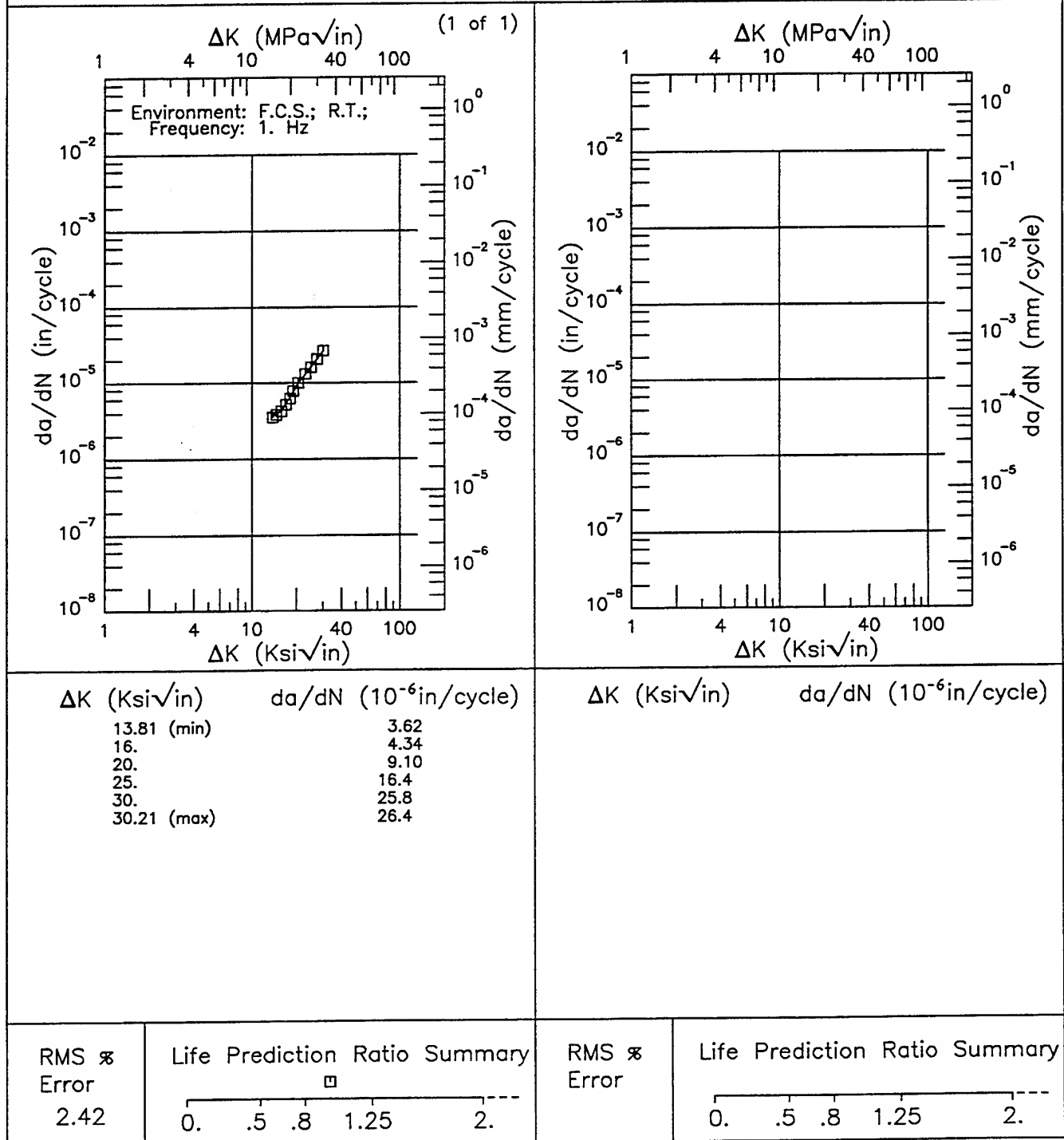


Figure 6.16.3.1.105

EF

Ti-6Al-4V

Condition/Ht: RA

Form: 0.38 in. Plate

Specimen Type: CT

Orientation: T-L

Stress Ratio: 0.1

Yield Strength: 141.7 - 149.2 ksi

Ult. Strength: 151.8 - 156.2 ksi

Specimen Thk: 0.372 - 0.375 in.

Specimen Width: 2.549 - 2.55 in.

Ref: 90981

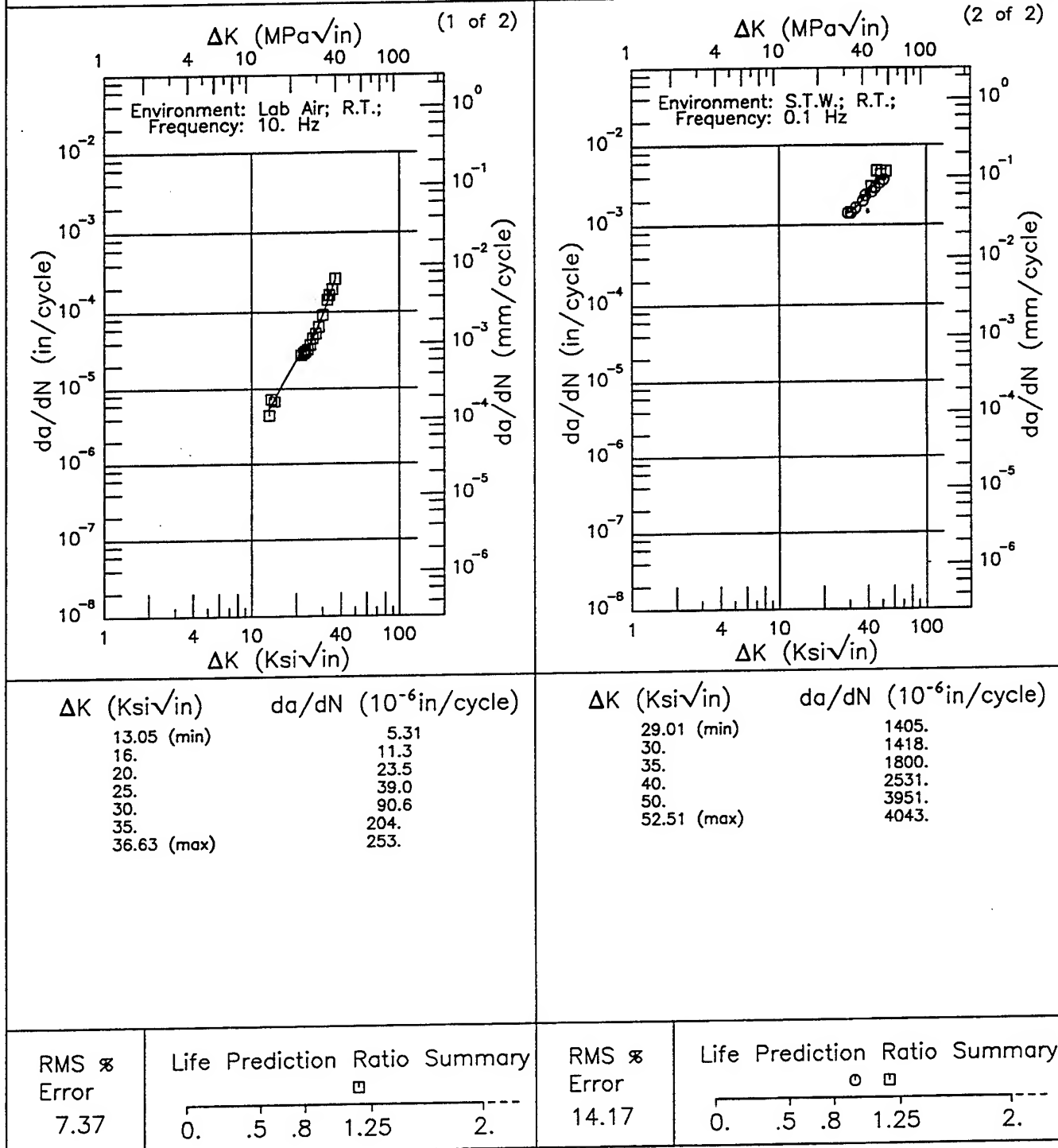


Figure 6.16.3.1.106

Condition/Ht: RA  
 Form: 0.13 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: T-L  
 Frequency: 10 Hz  
 Environment: H.H.A.; RT

Yield Strength: 149.1 - 149.2 ksi  
 Ult. Strength: 156.2 ksi  
 Specimen Thk: 0.124 - 0.125 in.  
 Specimen Width: 5 in.  
 Ref: 90981

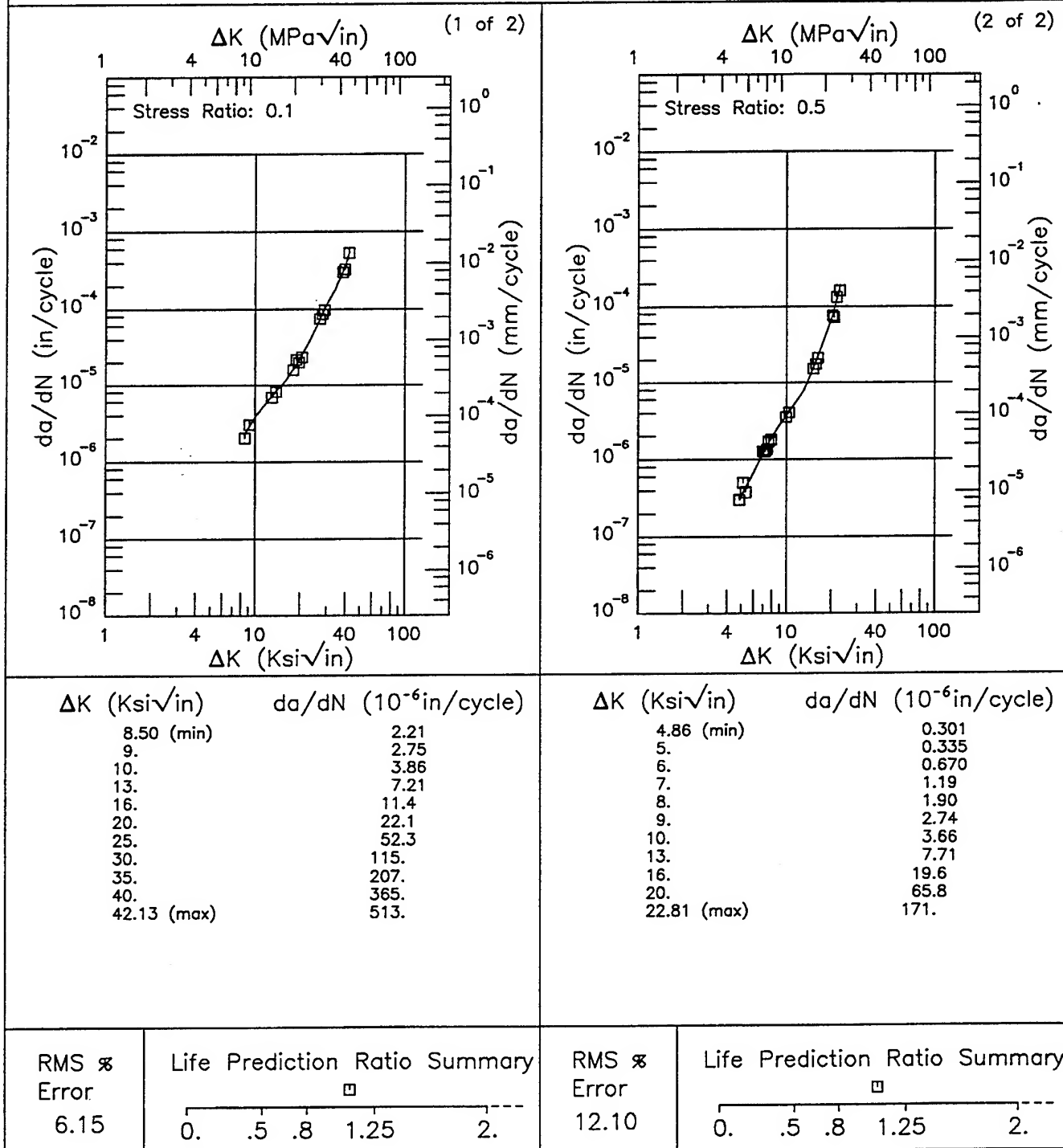
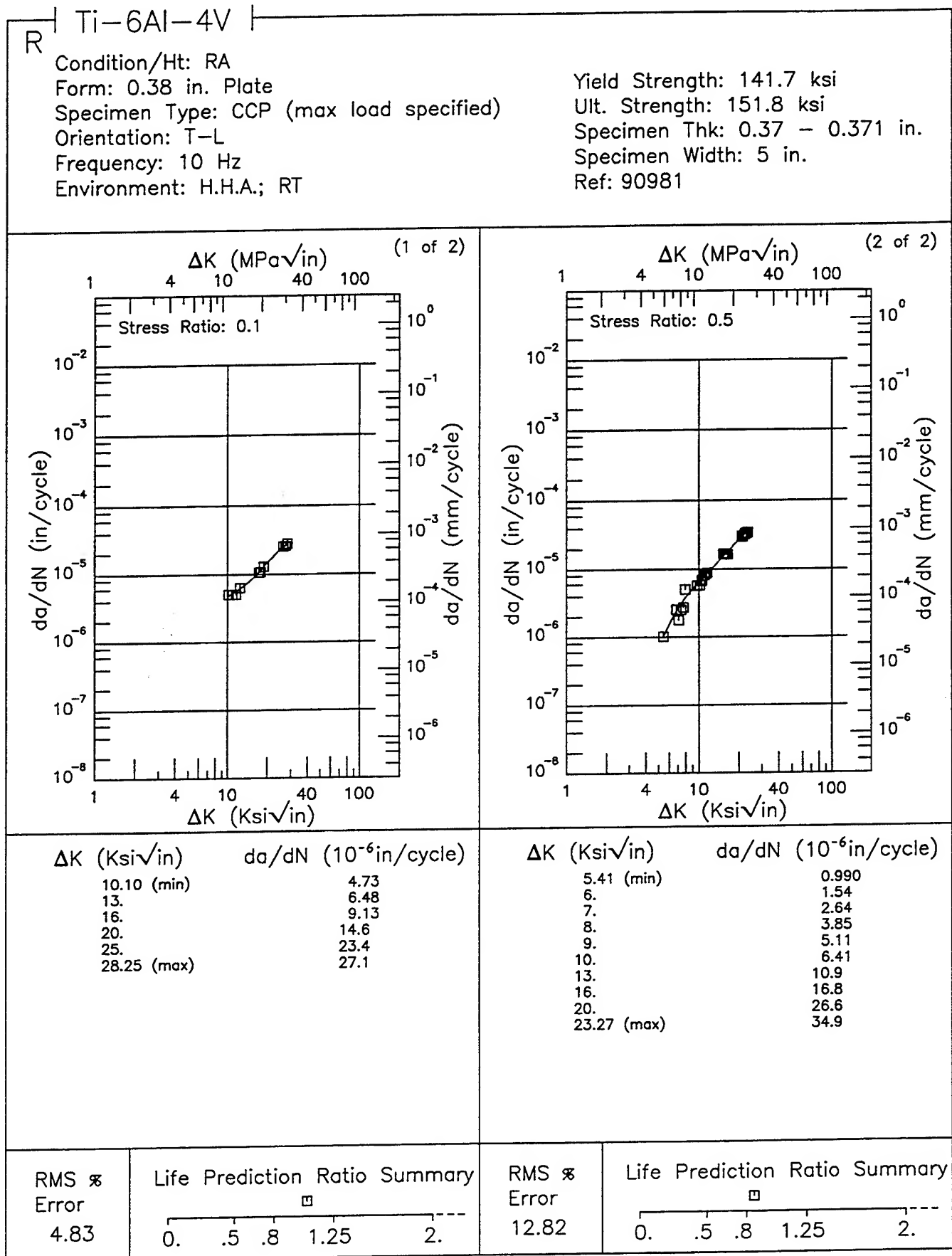


Figure 6.16.3.1.107



**Figure 6.16.3.1.108**

Condition/Ht: RA  
 Form: 0.38 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: T-L  
 Frequency: 10 Hz  
 Environment: 3.5% NaCl; RT

Yield Strength: 141.7 ksi  
 Ult. Strength: 151.8 ksi  
 Specimen Thk: 0.372 in.  
 Specimen Width: 5 in.  
 Ref: 90981

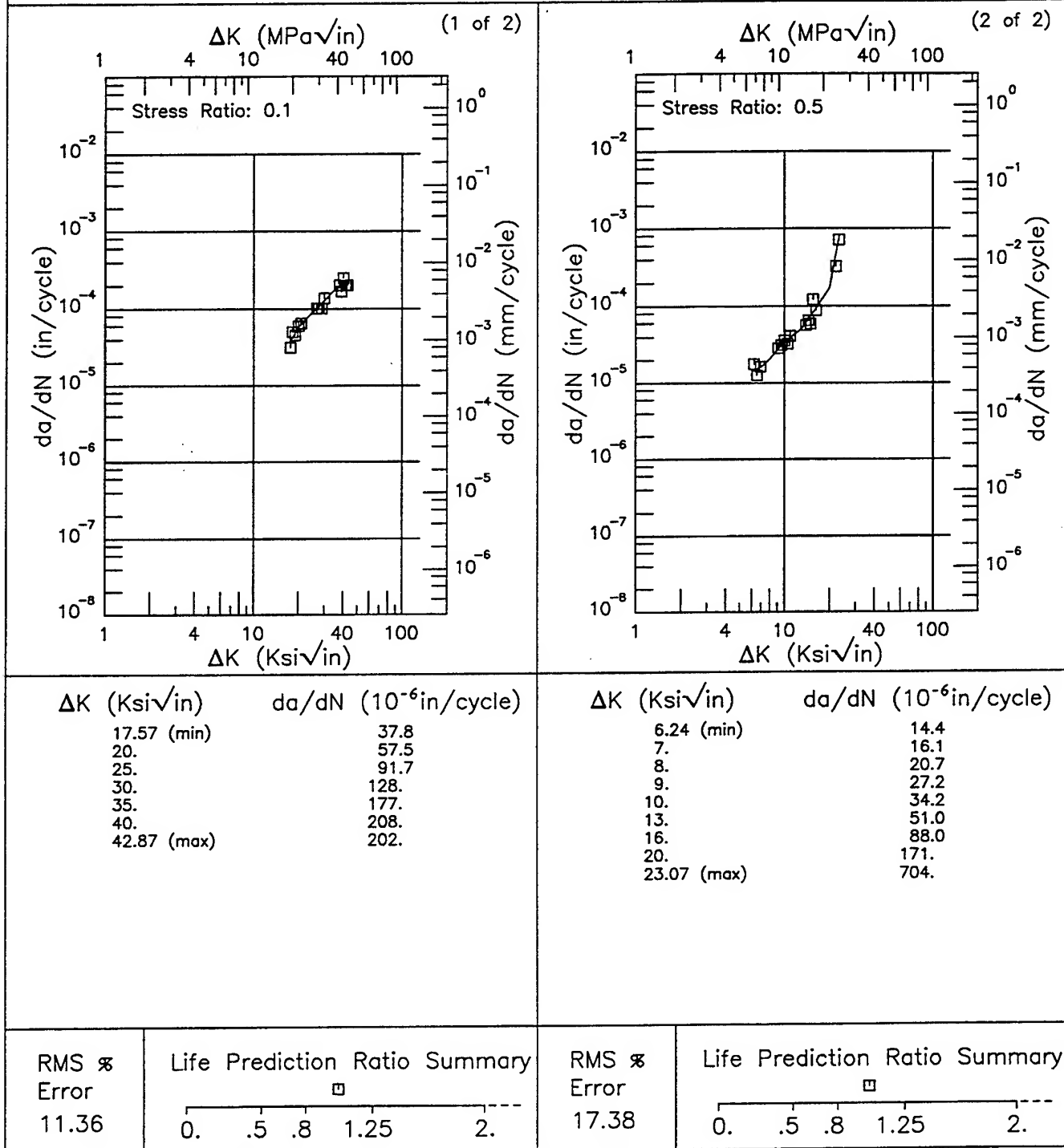
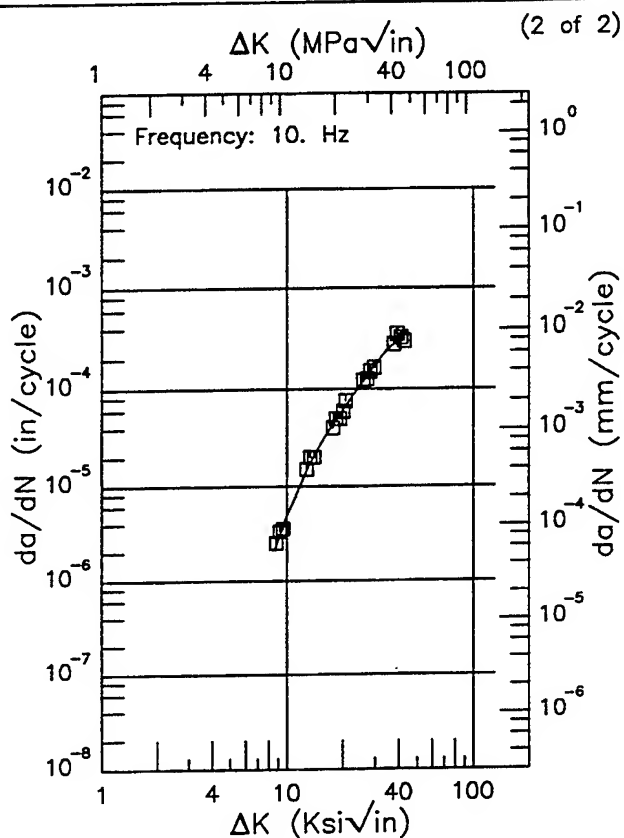
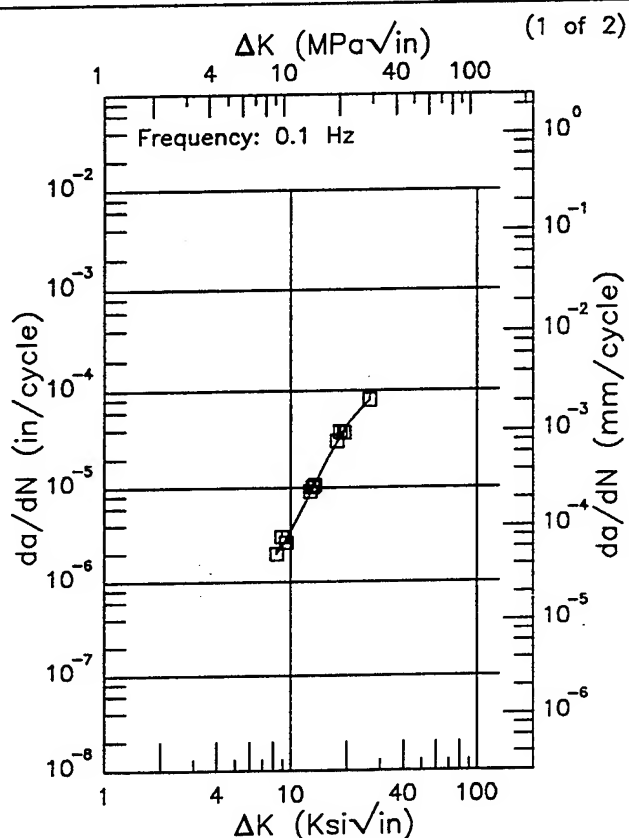


Figure 6.16.3.1.109

F | Ti-6Al-4V |

Condition/Ht: RA  
 Form: 0.13 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: T-L  
 Stress Ratio: 0.1  
 Environment: 3.5% NaCl; RT

Yield Strength: 149.2 ksi  
 Ult. Strength: 156.2 ksi  
 Specimen Thk: 0.125 in.  
 Specimen Width: 5 in.  
 Ref: 90981



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.36 (min)	2.00
9.	2.47
10.	3.50
13.	9.45
16.	21.1
20.	44.7
25.	74.0
26.41 (max)	79.4

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.72 (min)	2.25
9.	2.73
10.	4.91
13.	15.9
16.	32.4
20.	61.3
25.	110.
30.	173.
35.	249.
40.	314.
42.50 (max)	332.

RMS %  
 Error  
 9.49

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

RMS %  
 Error  
 8.34

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

Figure 6.16.3.1.110

**This page intentionally left blank**



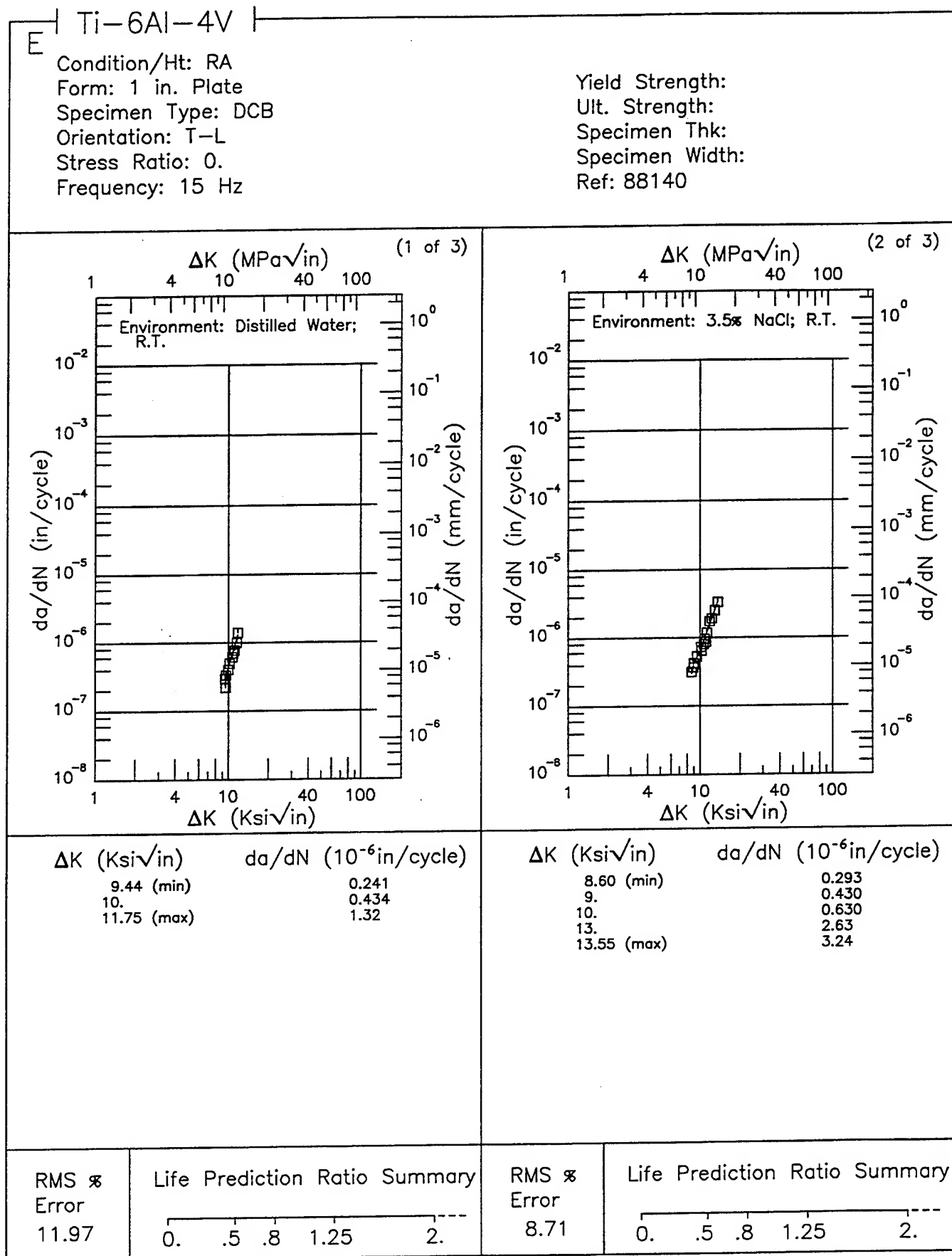


Figure 6.16.3.1.111

Condition/Ht: RA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.  
Frequency: 15 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140

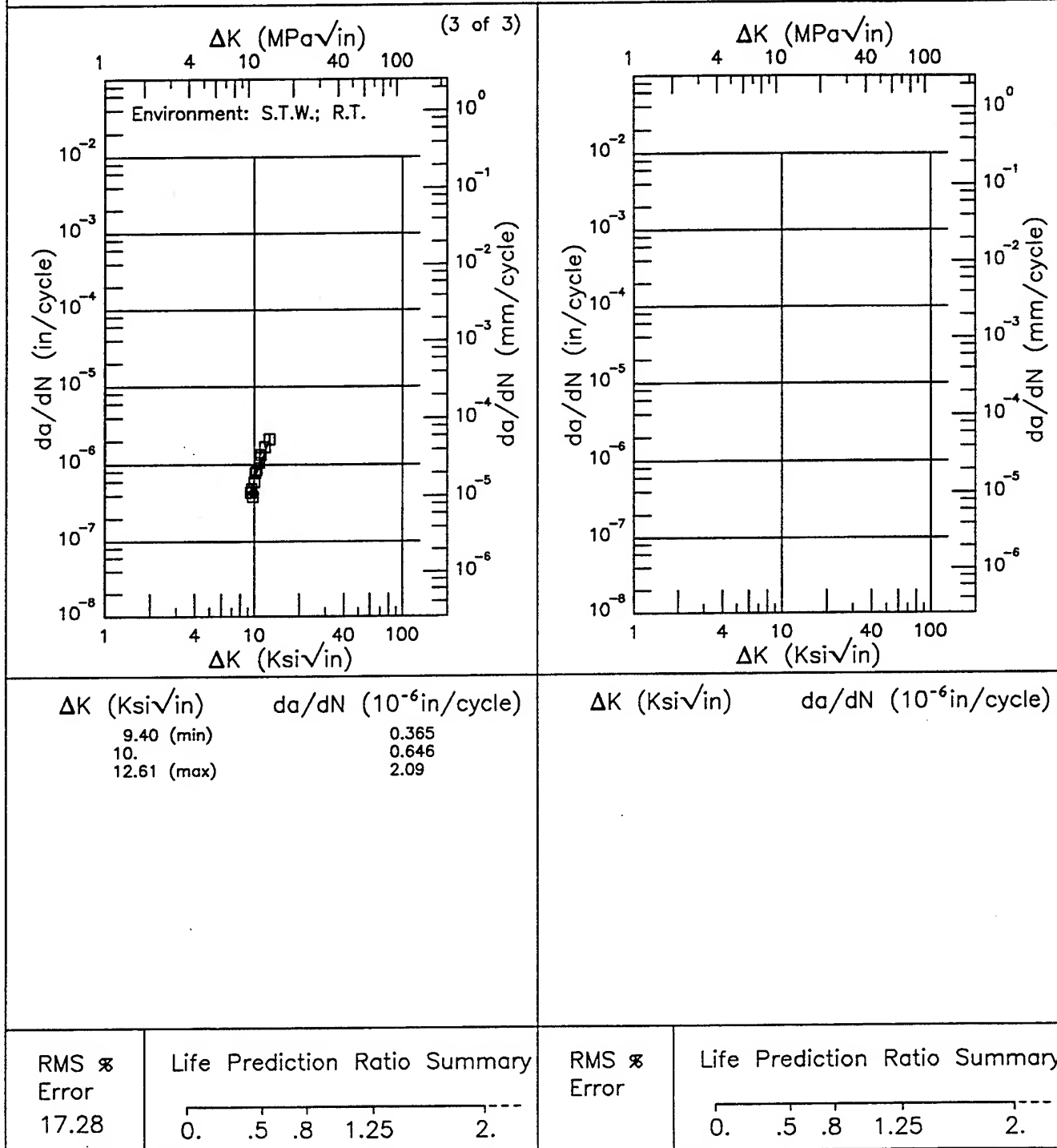
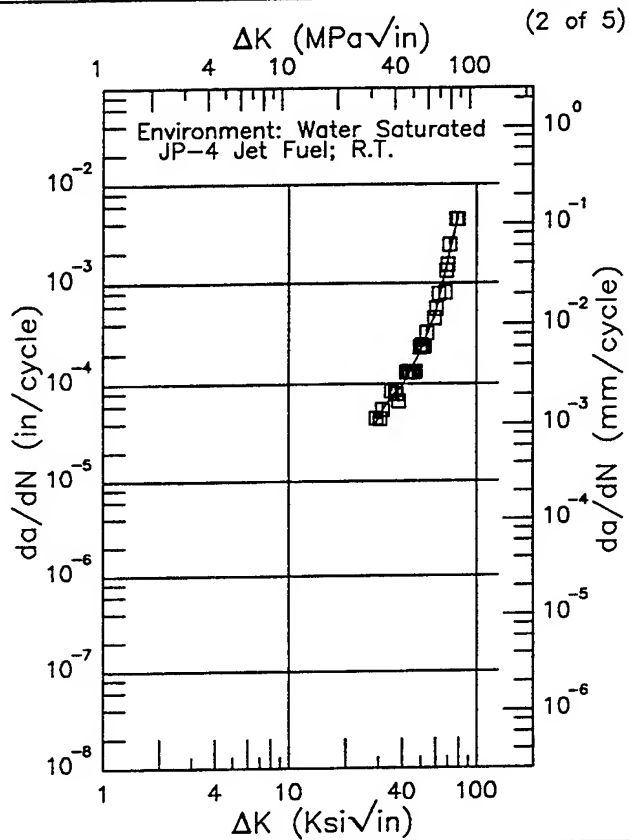
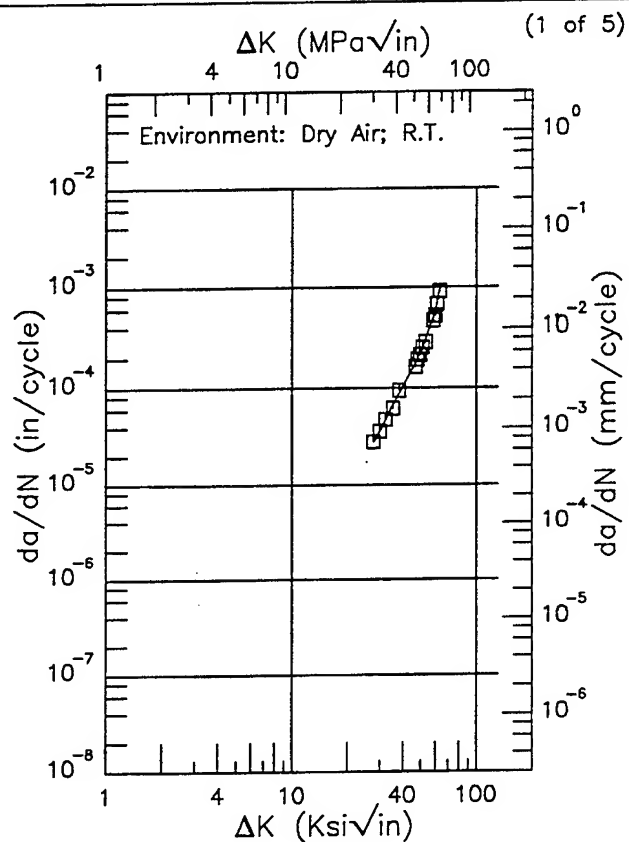


Figure 6.16.3.1.111 (Concluded)

E | Ti-6Al-4V |

Condition/Ht: RA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.1  
Frequency: 0.1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
27.66 (min)	28.5
30.	36.5
35.	66.4
40.	103.
50.	225.
60.	572.
62.76 (max)	914.

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
28.99 (min)	39.1
30.	46.5
35.	73.2
40.	93.7
50.	216.
60.	491.
70.	1567.
79.39 (max)	4895.

RMS %  
Error  
4.09

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
13.27

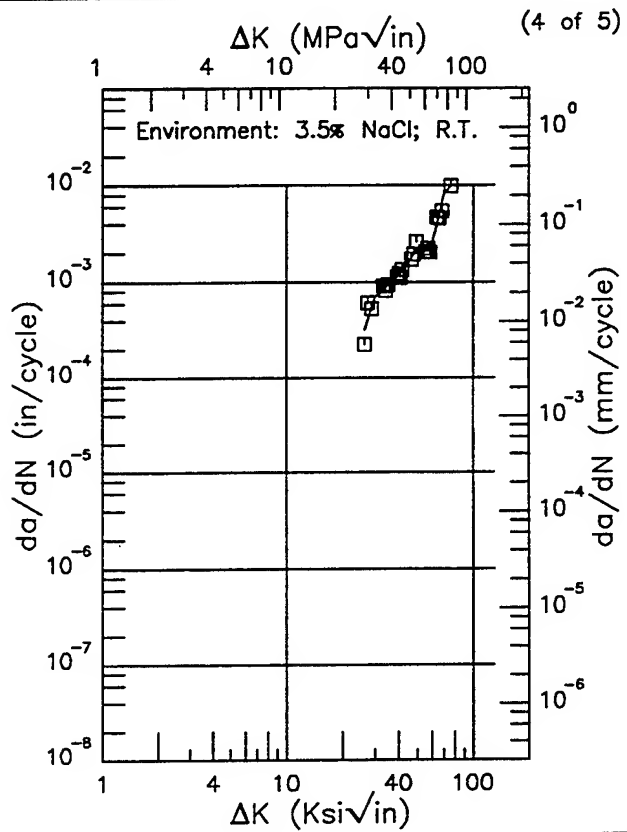
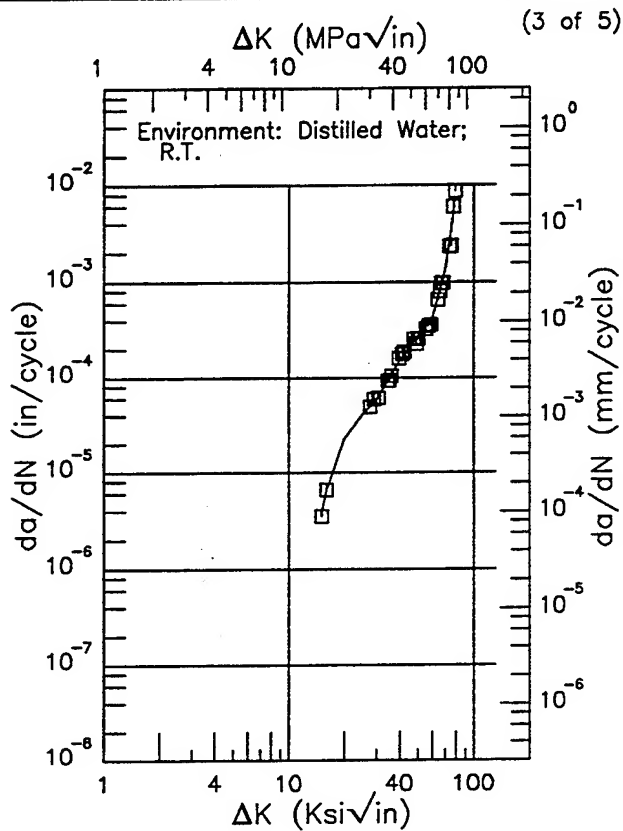
Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.16.3.1.112

Condition/Ht: RA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.1  
Frequency: 0.1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
14.90 (min)	3.68
16.	6.74
20.	22.5
25.	40.4
30.	59.8
35.	96.4
40.	154.
50.	270.
60.	428.
70.	1327.
78.93 (max)	7237.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
26.28 (min)	321.
30.	697.
35.	928.
40.	1173.
50.	2144.
60.	2469.
70.	8074.
75.42 (max)	9712.

RMS %  
Error  
10.54

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
16.28

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.16.3.1.112 (Continued)

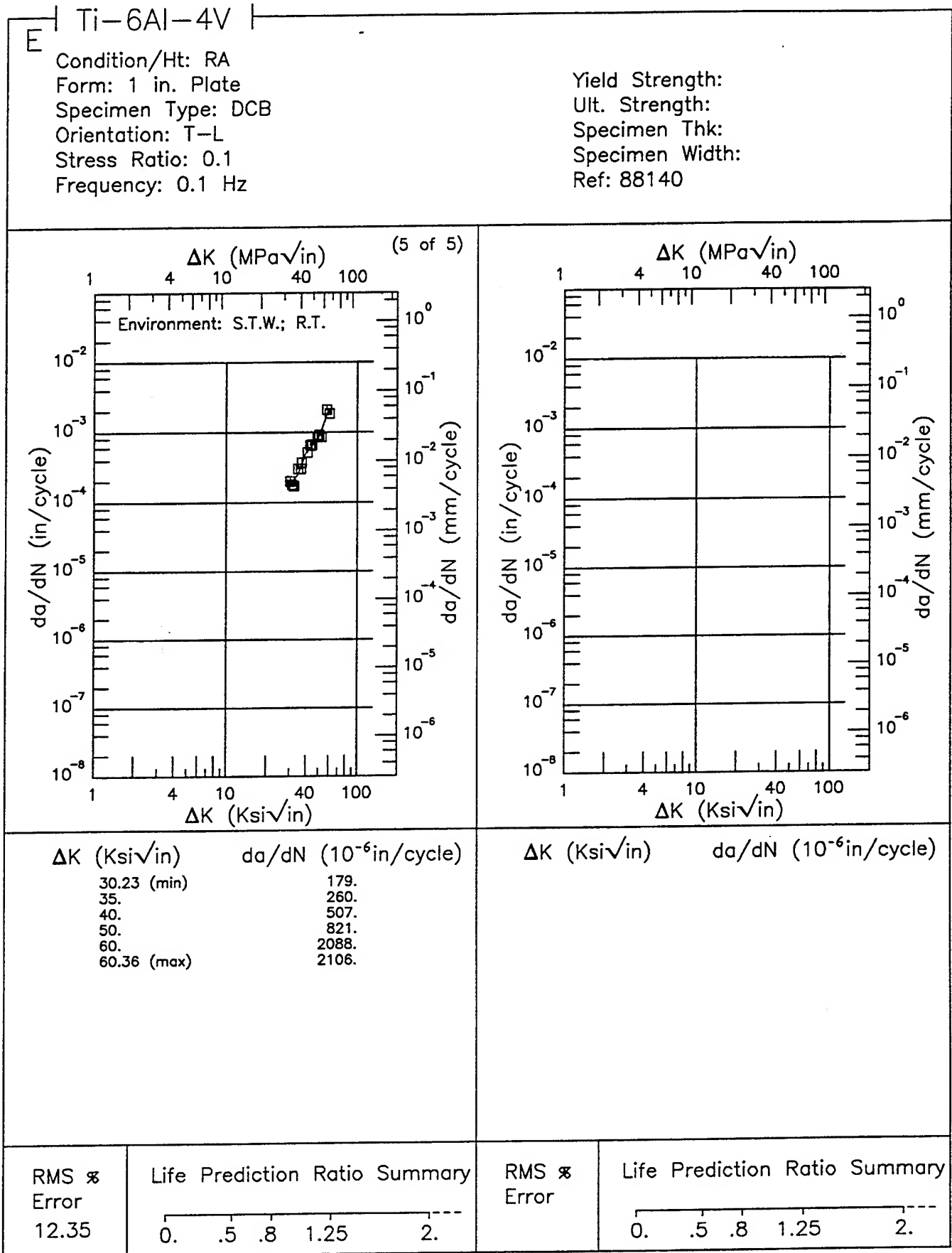
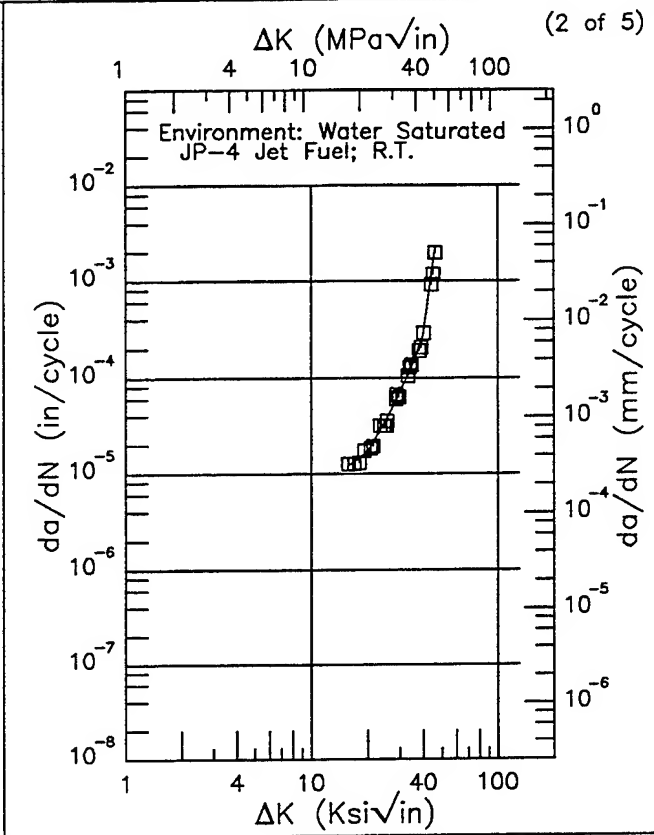
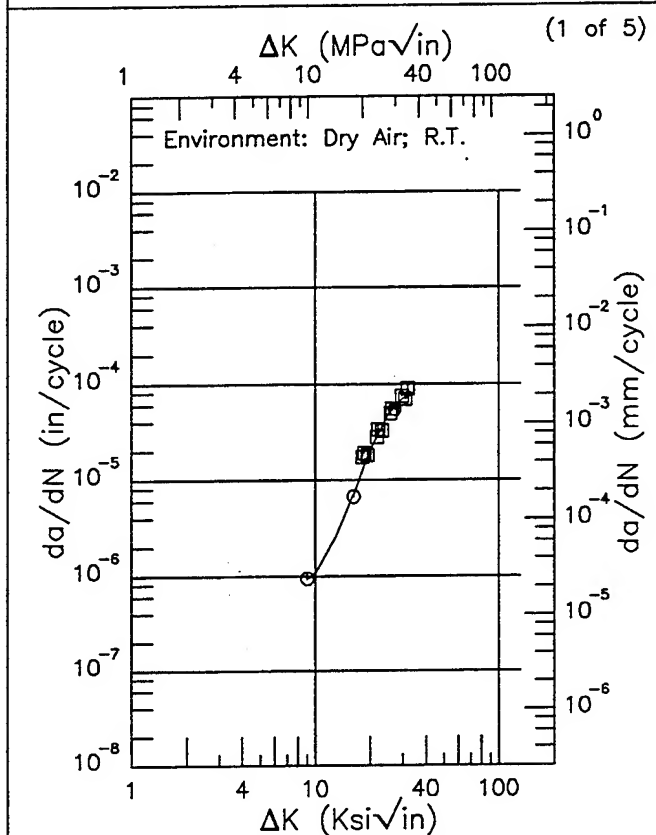


Figure 6.16.3.1.112 (Concluded)

Condition/Ht: RA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 0.1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.99 (min)	0.930
9.	0.930
10.	1.08
13.	2.57
16.	6.86
20.	20.4
25.	48.6
30.	70.2
31.84 (max)	72.2

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
15.67 (min)	12.1
16.	12.2
20.	17.2
25.	35.1
30.	71.4
35.	136.
40.	274.
46.00 (max)	2017.

RMS %  
Error  
16.54

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
9.48

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.16.3.1.113

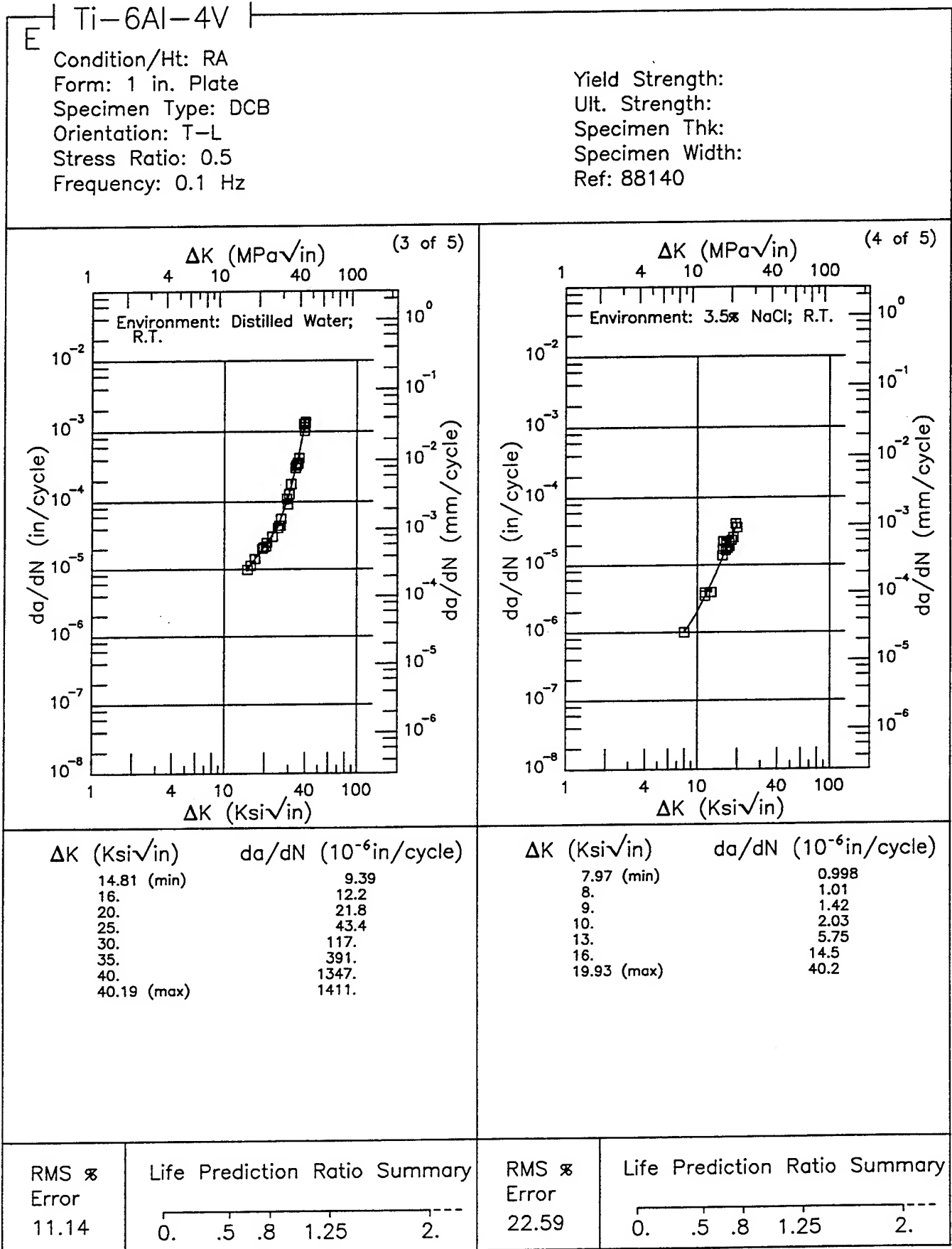


Figure 6.16.3.1.113 (Continued)

Condition/Ht: RA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 0.1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140

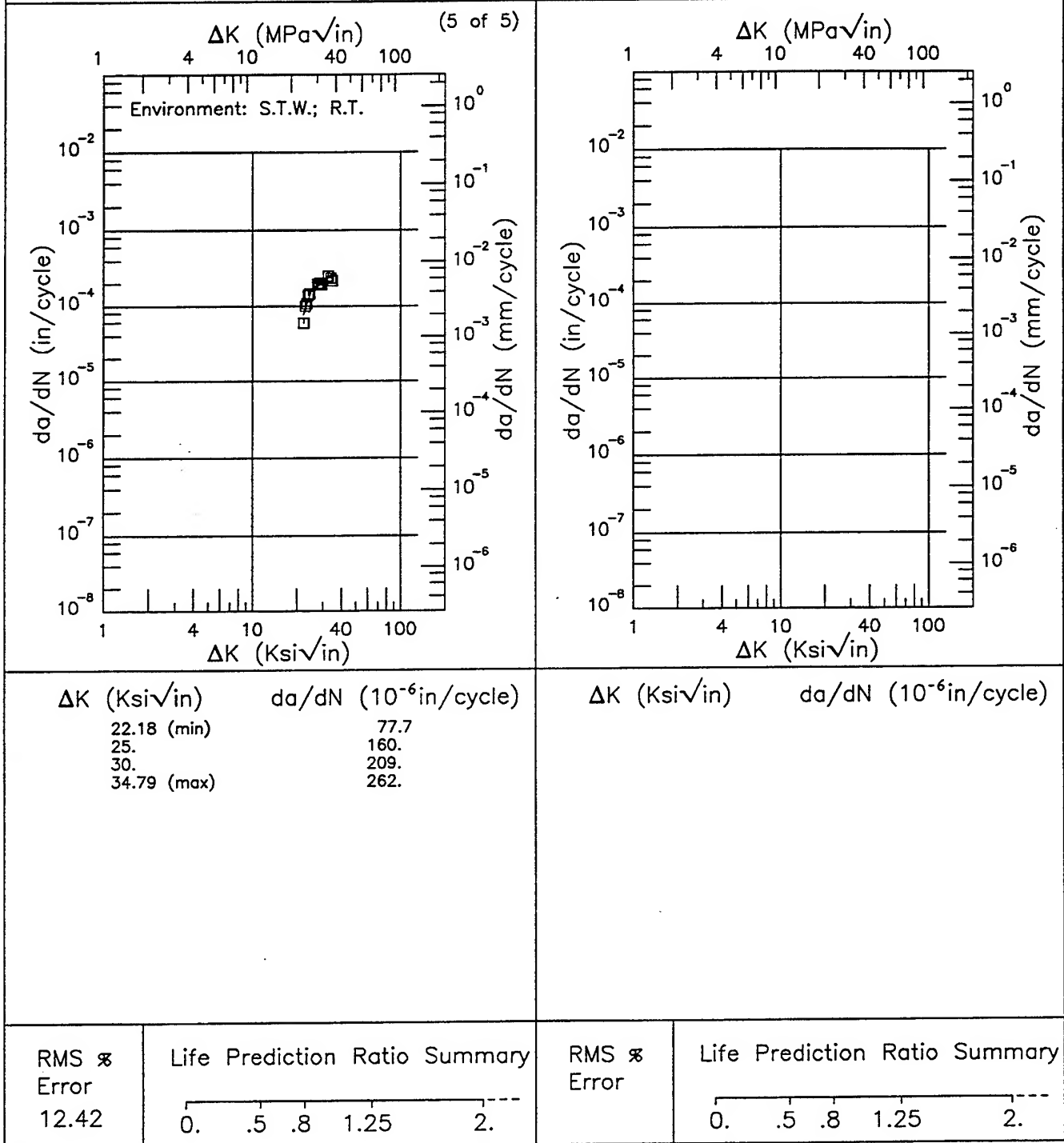


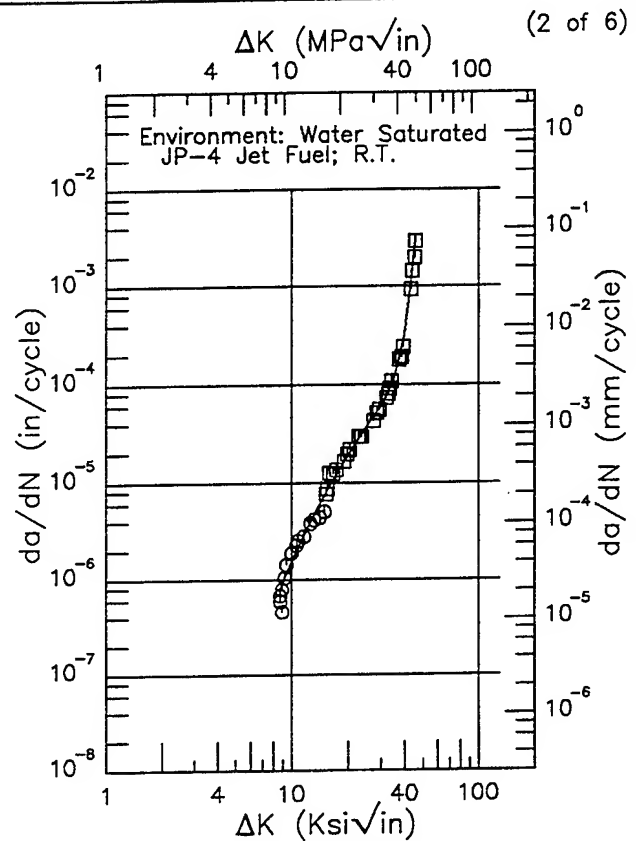
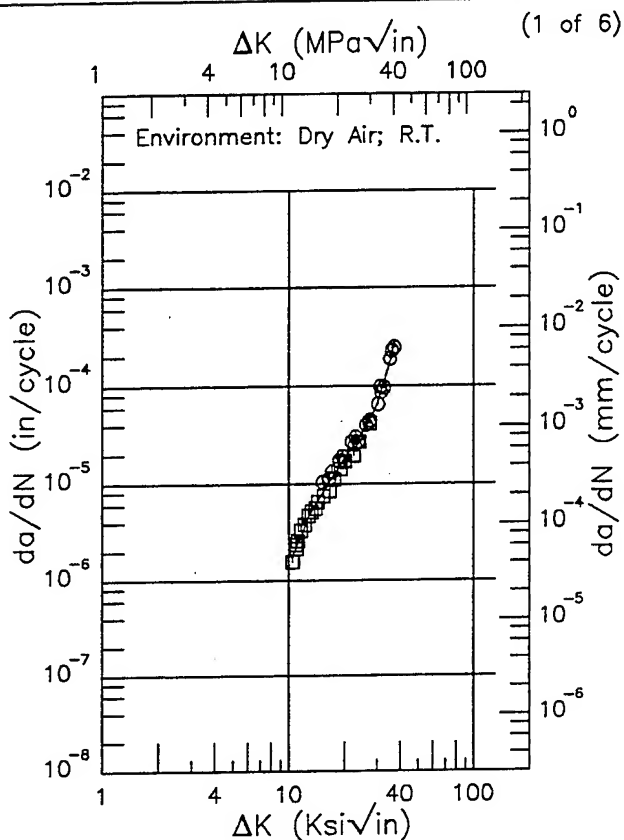
Figure 6.16.3.1.113 (Concluded)



E | Ti-6Al-4V |

Condition/Ht: RA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
10.40 (min)	1.74
13.	4.95
16.	9.60
20.	18.2
25.	33.6
30.	63.8
35.	171.
37.05 (max)	267.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.65 (min)	0.774
9.	0.943
10.	1.55
13.	4.49
16.	9.27
20.	19.1
25.	37.0
30.	60.0
35.	112.
40.	327.
45.45 (max)	2981.

RMS %  
Error  
11.40

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
16.68

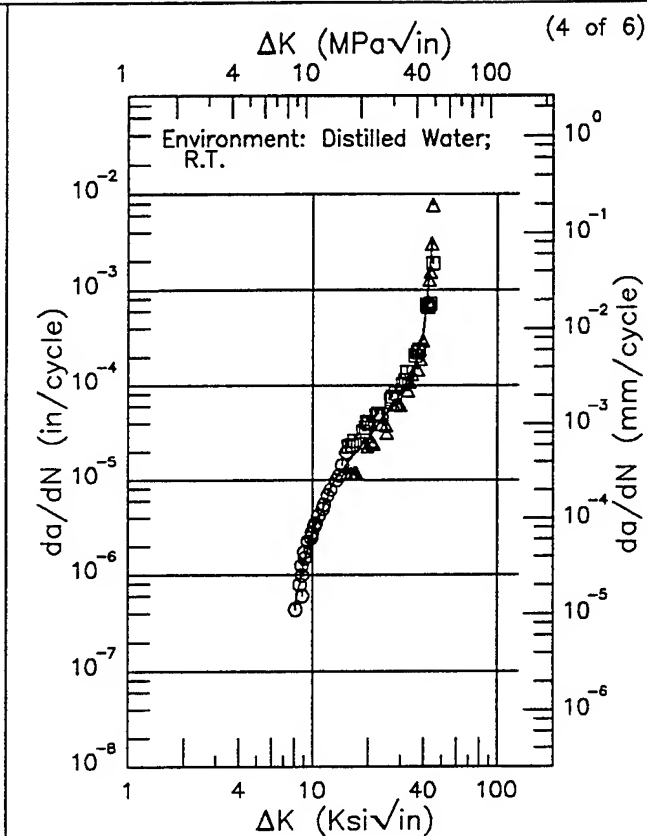
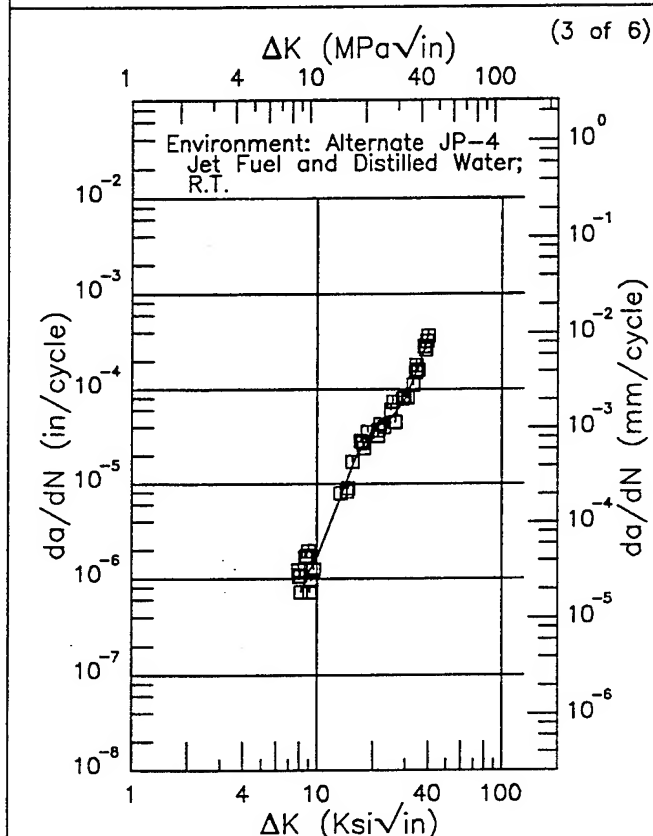
Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.16.3.1.114

Condition/Ht: RA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
7.94 (min)	0.985
8.	0.986
9.	1.17
10.	1.66
13.	6.23
16.	18.4
20.	37.8
25.	49.5
30.	77.9
35.	168.
39.99 (max)	349.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.08 (min)	0.475
9.	1.29
10.	2.77
13.	9.43
16.	16.6
20.	28.0
25.	49.3
30.	82.5
35.	147.
40.	372.
44.64 (max)	3246.

RMS % Error	Life Prediction Ratio Summary
23.26	0. 0.5 0.8 1.25 2. ---

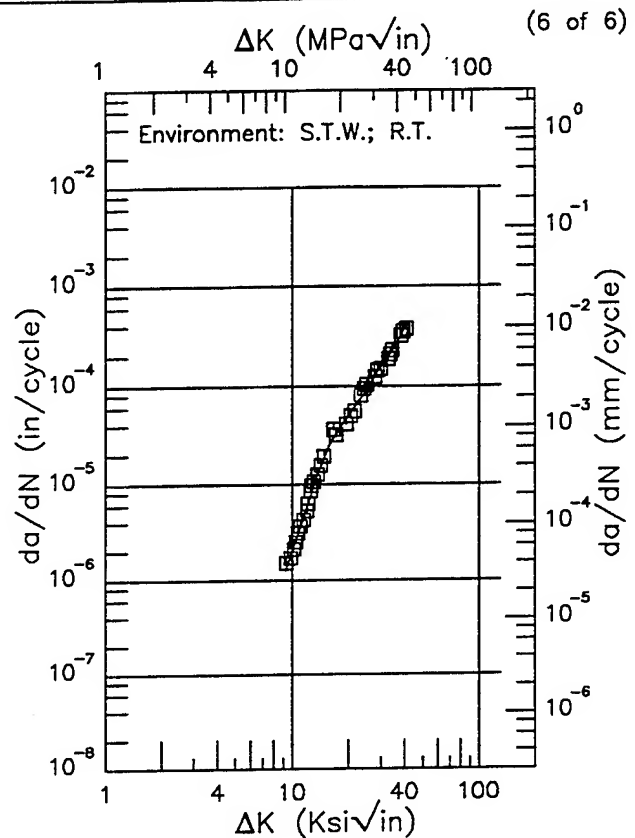
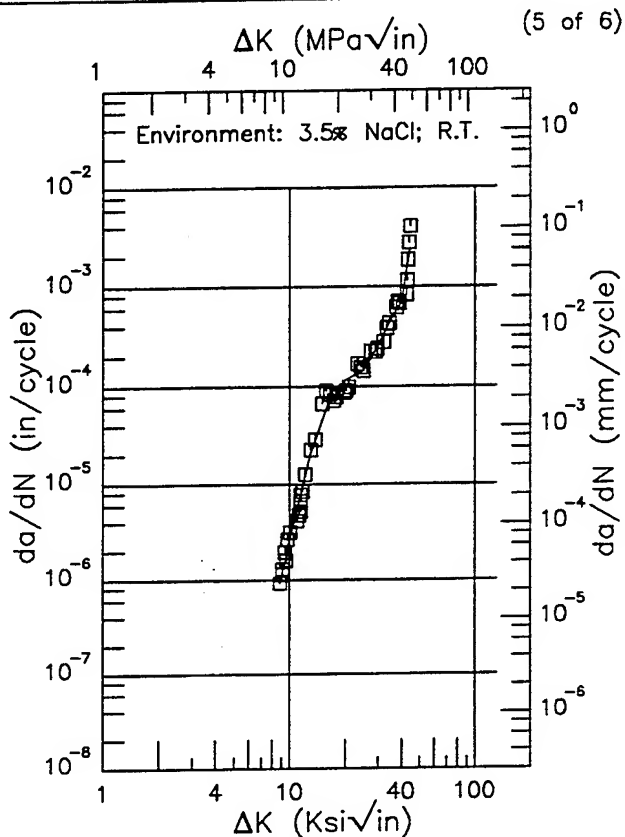
RMS % Error	Life Prediction Ratio Summary
29.23	0. 0.5 0.8 1.25 2. ---

Figure 6.16.3.1.114 (Continued)

Ti-6Al-4V

Condition/Ht: RA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
8.86 (min)	0.946
9.	1.08
10.	2.67
13.	20.4
16.	65.4
20.	115.
25.	147.
30.	261.
35.	464.
40.	698.
44.53 (max)	2388.

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
9.27 (min)	1.26
10.	2.01
13.	9.57
16.	26.0
20.	51.3
25.	88.7
30.	160.
35.	235.
40.	377.
40.49 (max)	406.

RMS %  
Error  
22.38

Life Prediction Ratio Summary  
0. .5 .8 1.25 2. ---

RMS %  
Error  
9.34

Life Prediction Ratio Summary  
0. .5 .8 1.25 2. ---

Figure 6.16.3.1.114 (Concluded)

**This page intentionally left blank**

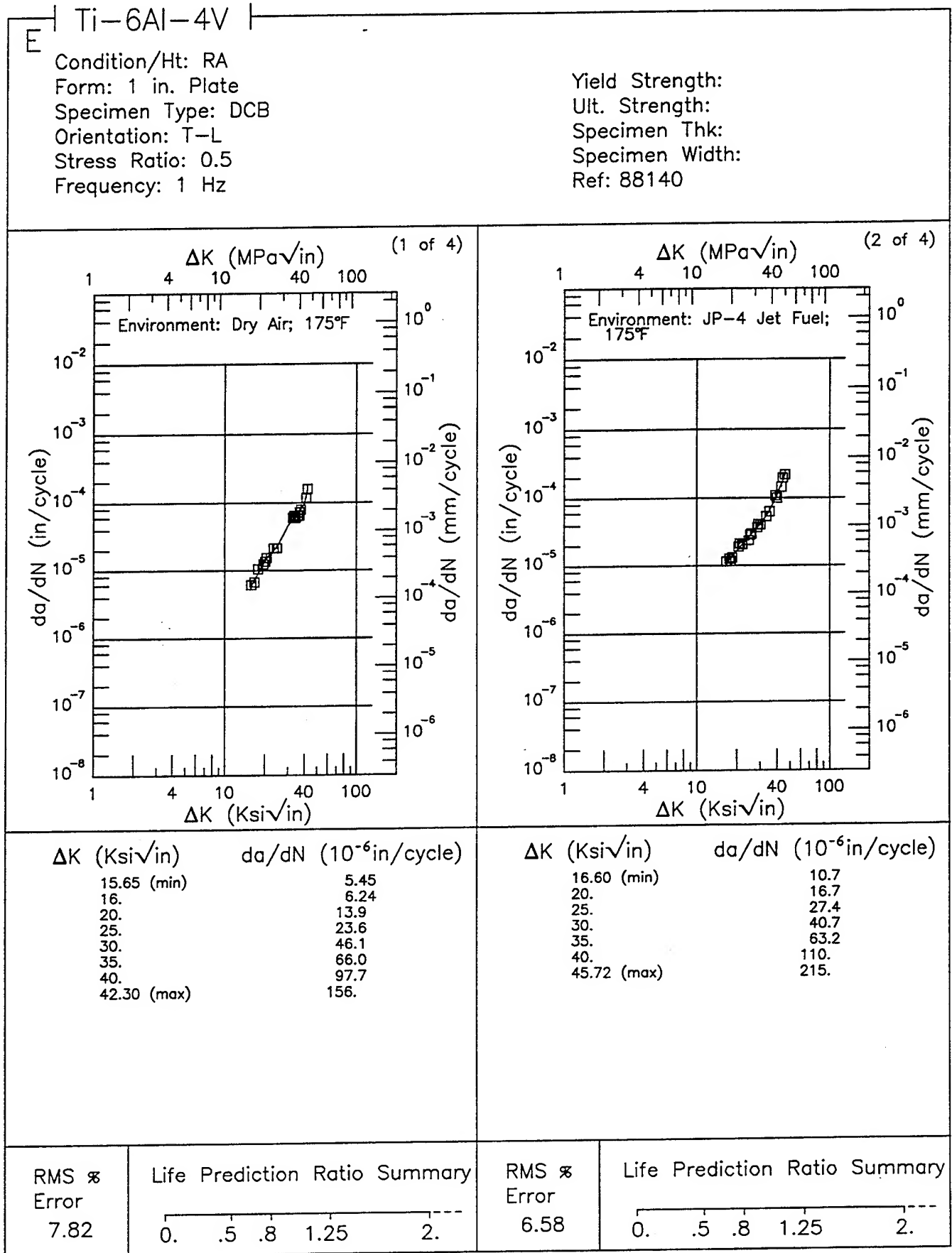
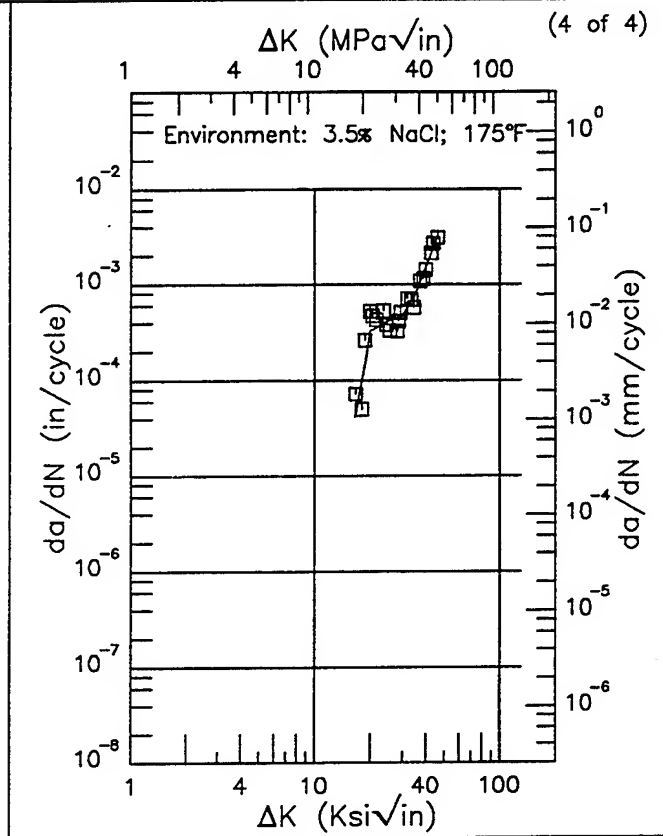
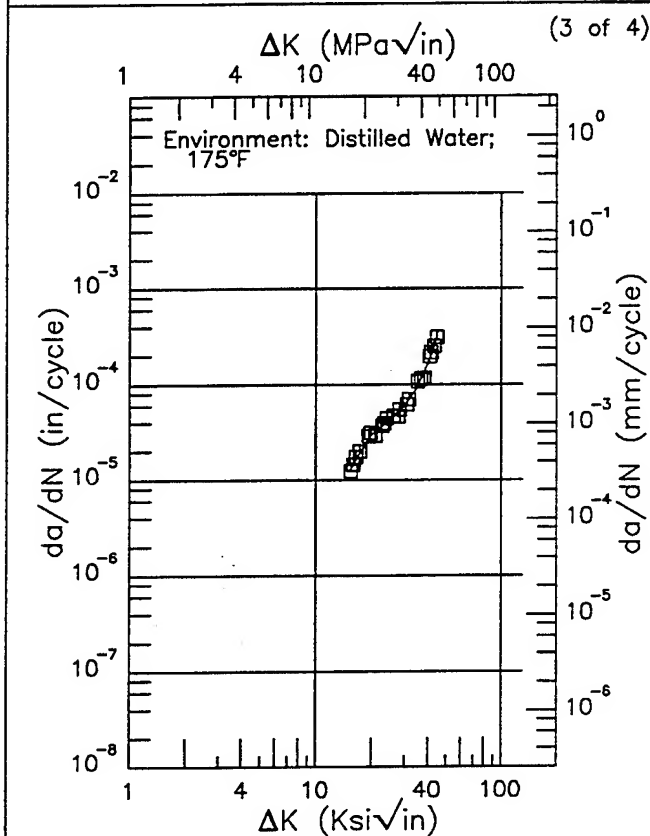


Figure 6.16.3.1.115

Condition/Ht: RA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



ΔK (Ksi√in)	da/dN (10⁻⁶ in/cycle)
15.44 (min)	12.7
16.	15.0
20.	29.8
25.	43.2
30.	60.3
35.	94.7
40.	168.
44.48 (max)	304.

ΔK (Ksi√in)	da/dN (10⁻⁶ in/cycle)
16.62 (min)	41.8
20.	326.
25.	416.
30.	474.
35.	786.
40.	1507.
46.18 (max)	3196.

RMS %  
Error  
6.23

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
33.19

Life Prediction Ratio Summary

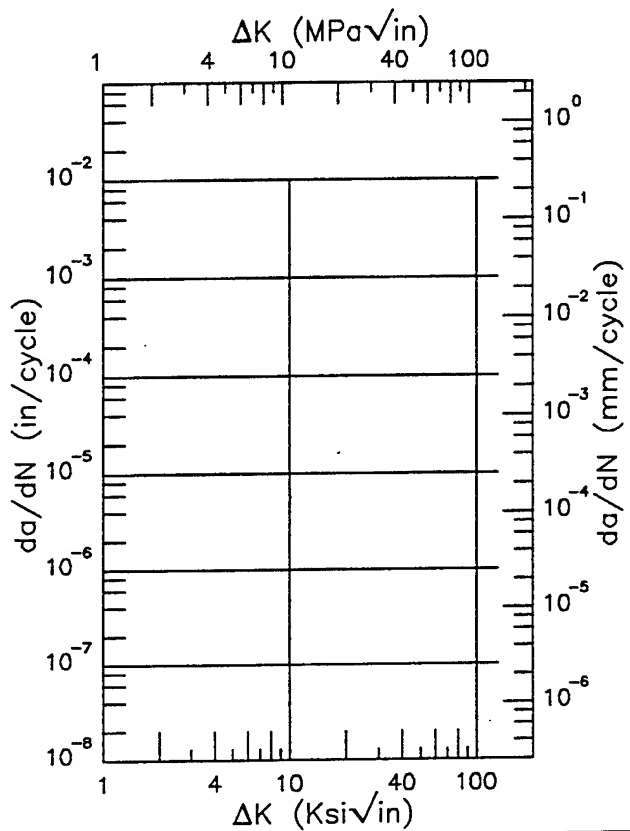
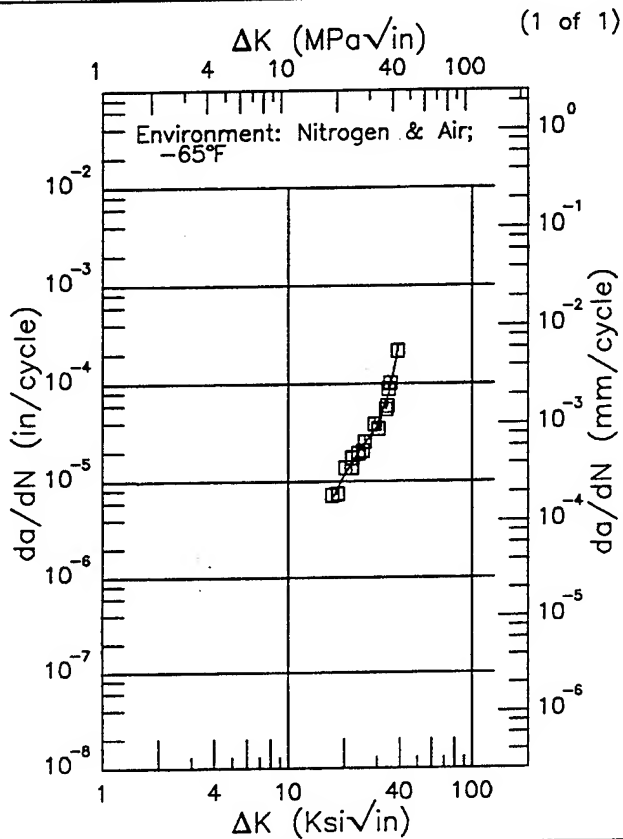
0. .5 .8 1.25 2.---

Figure 6.16.3.1.115 (Concluded)

Ti-6Al-4V

Condition/Ht: RA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140

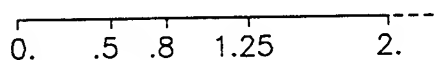


$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}\text{in/cycle}$ )
17.05 (min)	6.45
20.	11.5
25.	23.0
30.	36.0
35.	82.3
39.00 (max)	218.

$$\Delta K \text{ (Ksi}\sqrt{\text{in}}) \quad da/dN \text{ (10}^{-6}\text{in/cycle)}$$

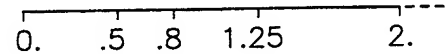
RMS Error  
11.50

## Life Prediction Ratio Summary



RMS Error

### Life Prediction Ratio Summary



**Figure 6.16.3.1.116**

Condition/Ht: RA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.8  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140

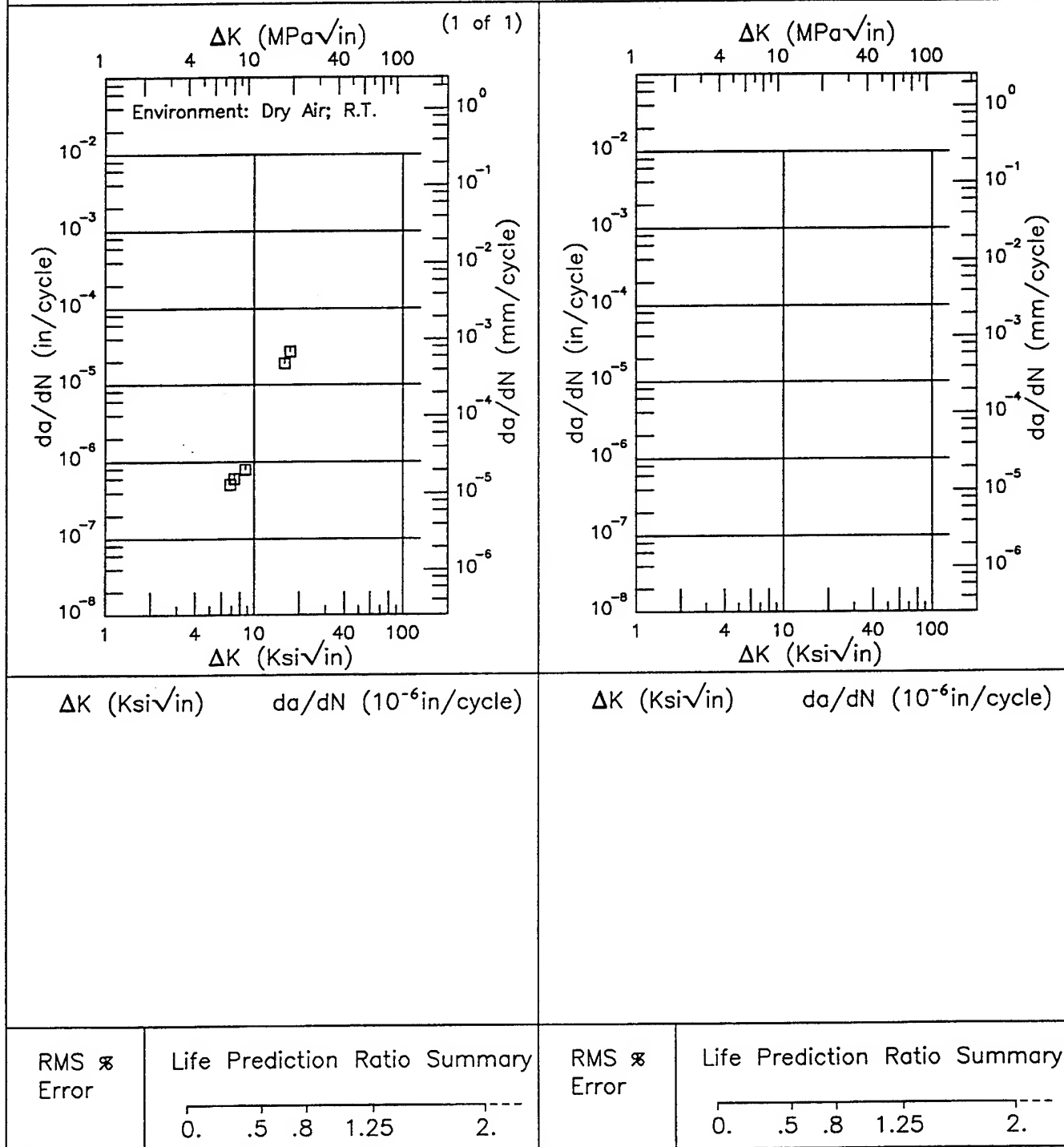


Figure 6.16.3.1.117



Ti-6Al-4V

Condition/Ht: RA

Form: 0.38 in. Plate

Specimen Type: PTSF (max stress specified)

Orientation: L-S

Stress Ratio: 0.1

Frequency: 10 Hz

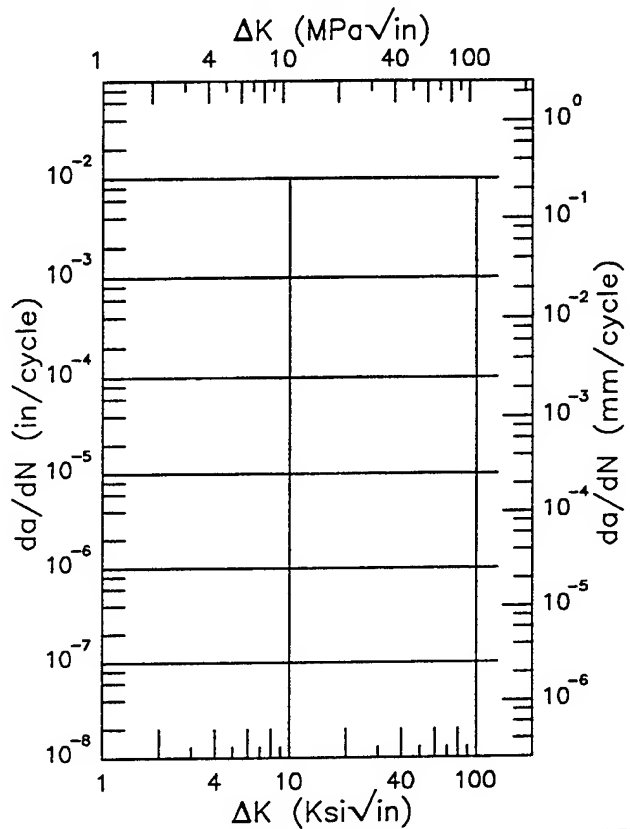
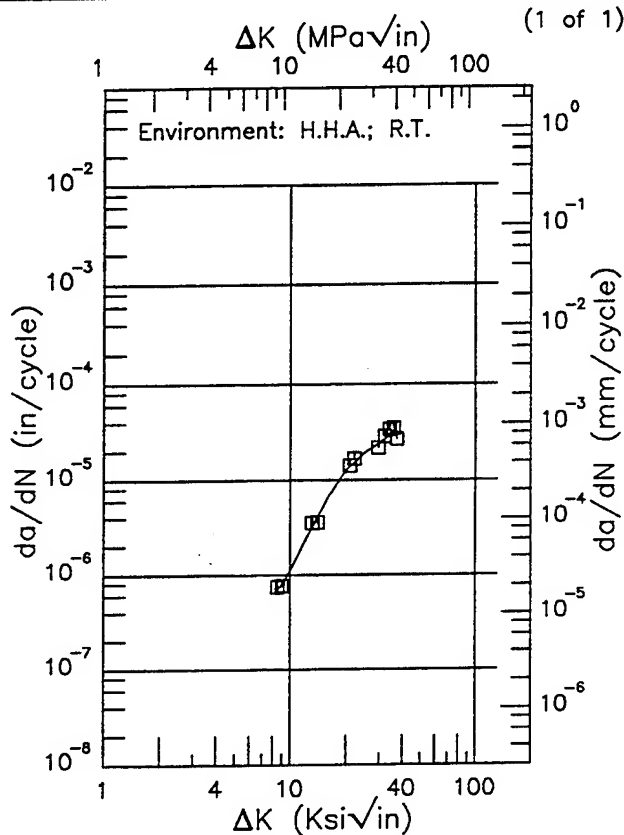
Yield Strength: 119.1 ksi

Ult. Strength: 138.1 ksi

Specimen Thk: 0.376 in.

Specimen Width: 5 in.

Ref: 90981



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
8.50 (min)	0.676
9.	0.789
10.	1.11
13.	3.02
16.	6.66
20.	12.8
25.	19.3
30.	24.2
35.	30.9
37.14 (max)	35.6

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )      da/dN (10<sup>-6</sup>in/cycle)

RMS %  
Error

11.89

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error

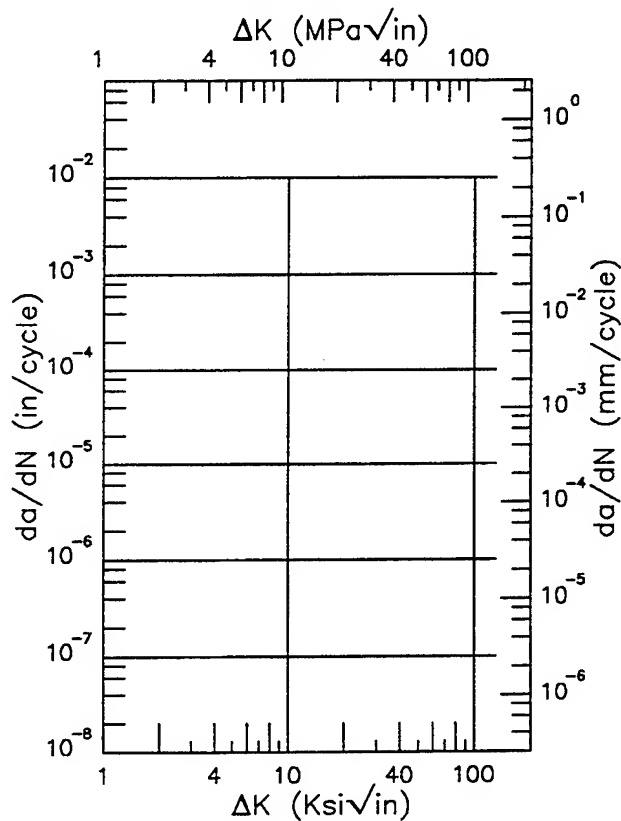
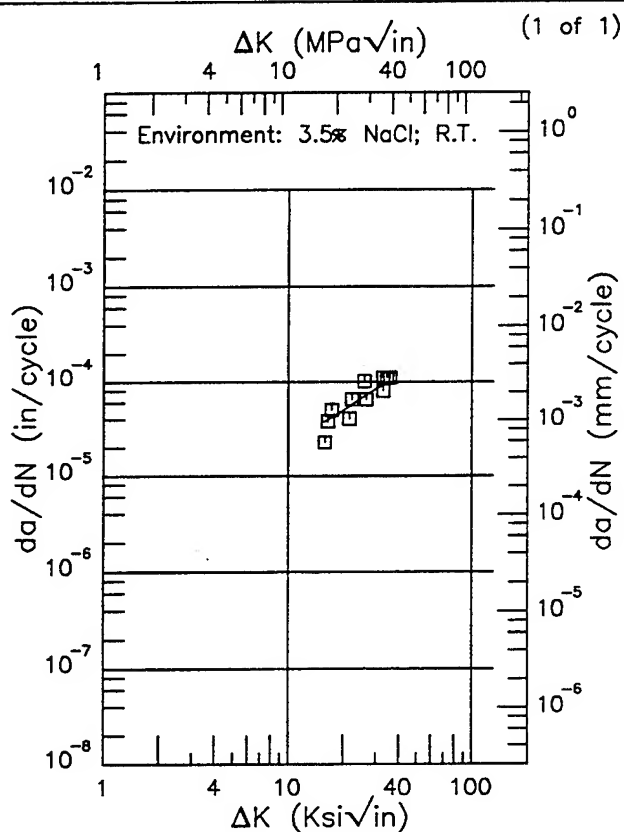
Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.16.3.1.118

Condition/Ht: RA  
Form: 0.38 in. Plate  
Specimen Type: PTSF (max stress specified)  
Orientation: T-S  
Stress Ratio: 0.1  
Frequency: 10 Hz

Yield Strength: 141.7 ksi  
Ult. Strength: 151.8 ksi  
Specimen Thk: 0.377 in.  
Specimen Width: 5 in.  
Ref: 90981



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
15.77 (min)	37.3
16.	37.9
20.	49.7
25.	67.2
30.	84.6
35.	99.2
35.80 (max)	101.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
--------------------------------------	-----------------------------------

RMS %  
Error  
22.73

Life Prediction Ratio Summary

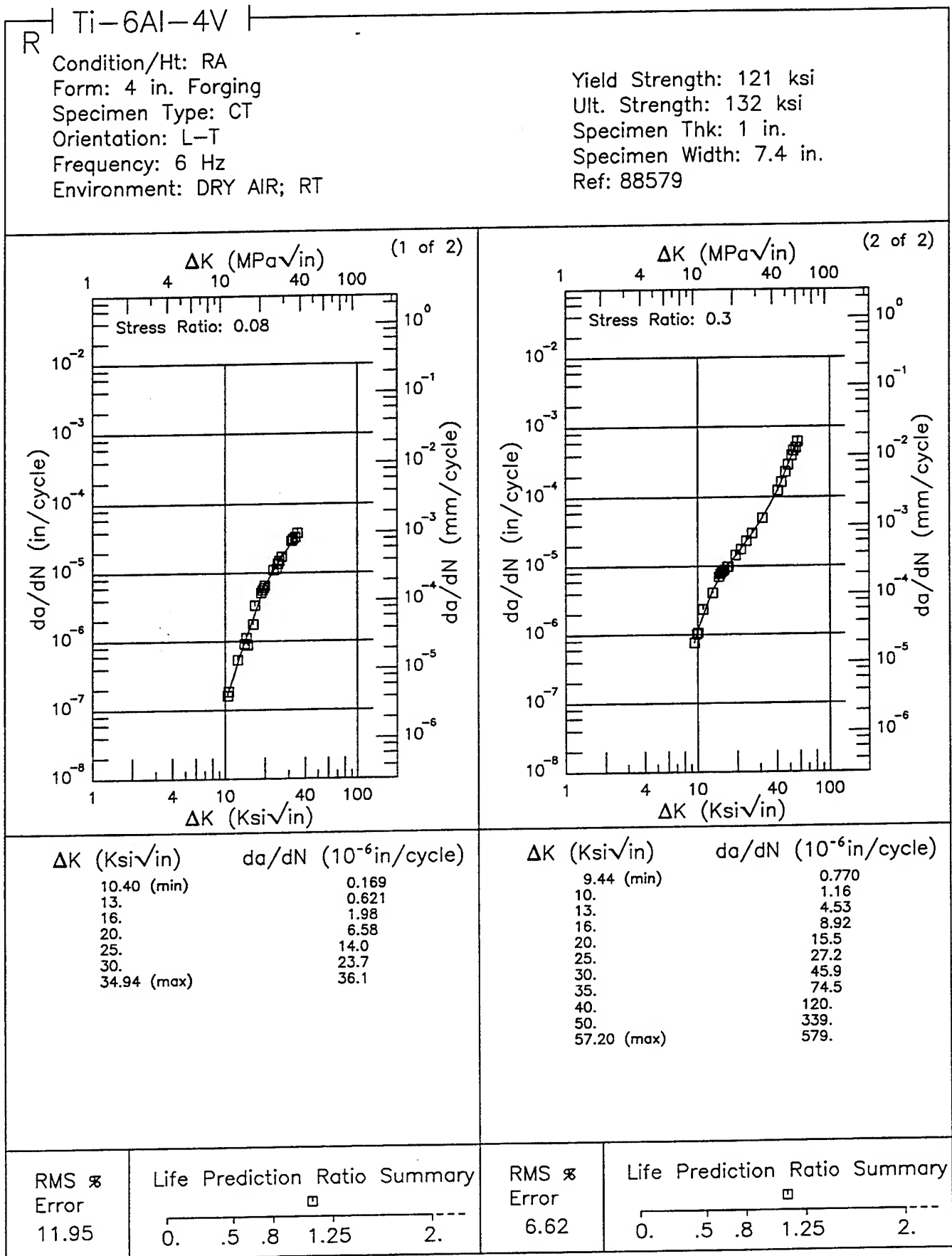
0. .5 .8 1.25 2. ---

RMS %  
Error

Life Prediction Ratio Summary

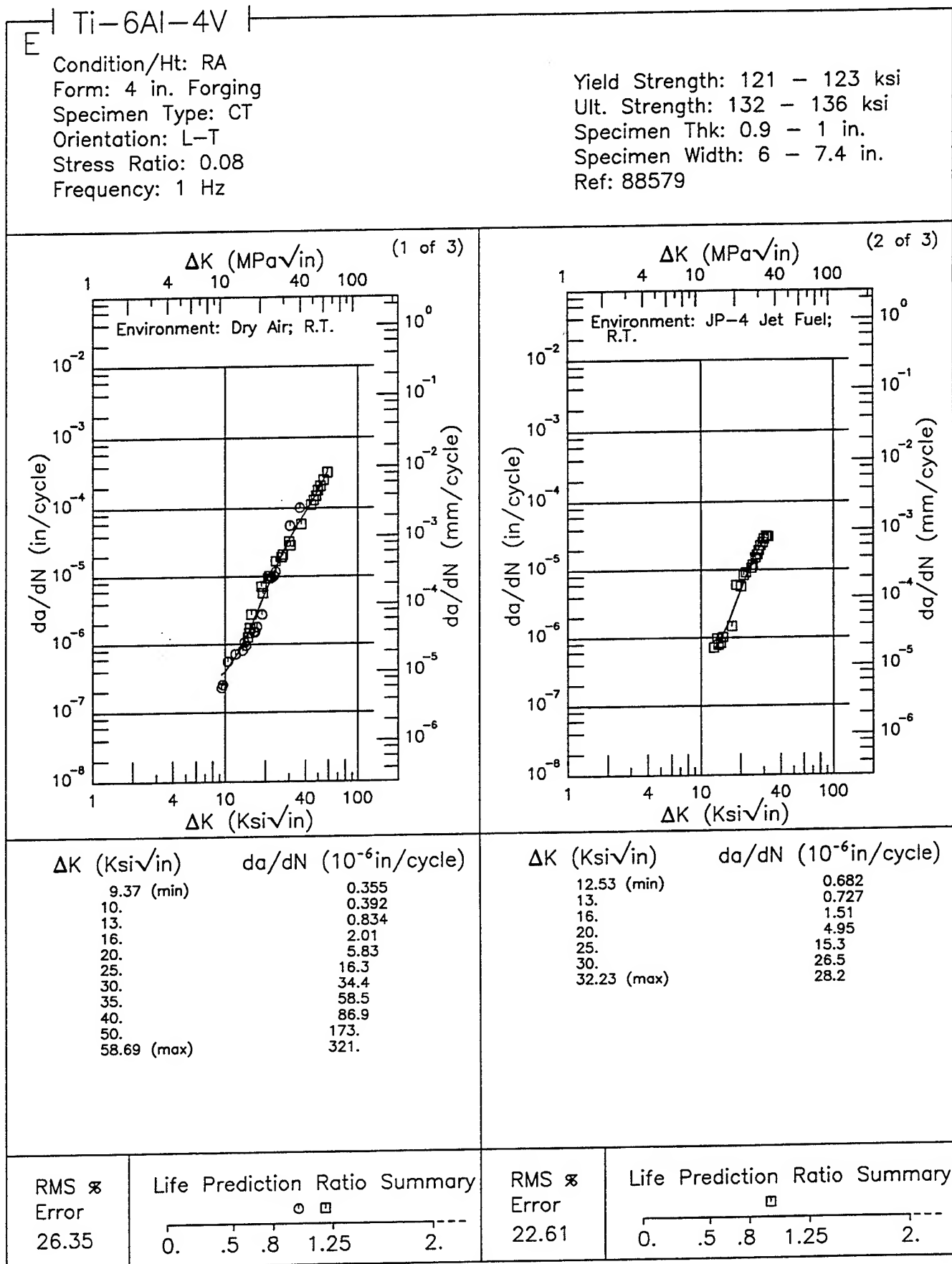
0. .5 .8 1.25 2. ---

Figure 6.16.3.1.119



**Figure 6.16.3.1.120**

**This page intentionally left blank**



**Figure 6.16.3.1.121**

Condition/Ht: RA  
Form: 4 in. Forging  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.08  
Frequency: 1 Hz

Yield Strength: 121 - 123 ksi  
Ult. Strength: 132 - 136 ksi  
Specimen Thk: 0.9 - 1 in.  
Specimen Width: 6 - 7.4 in.  
Ref: 88579

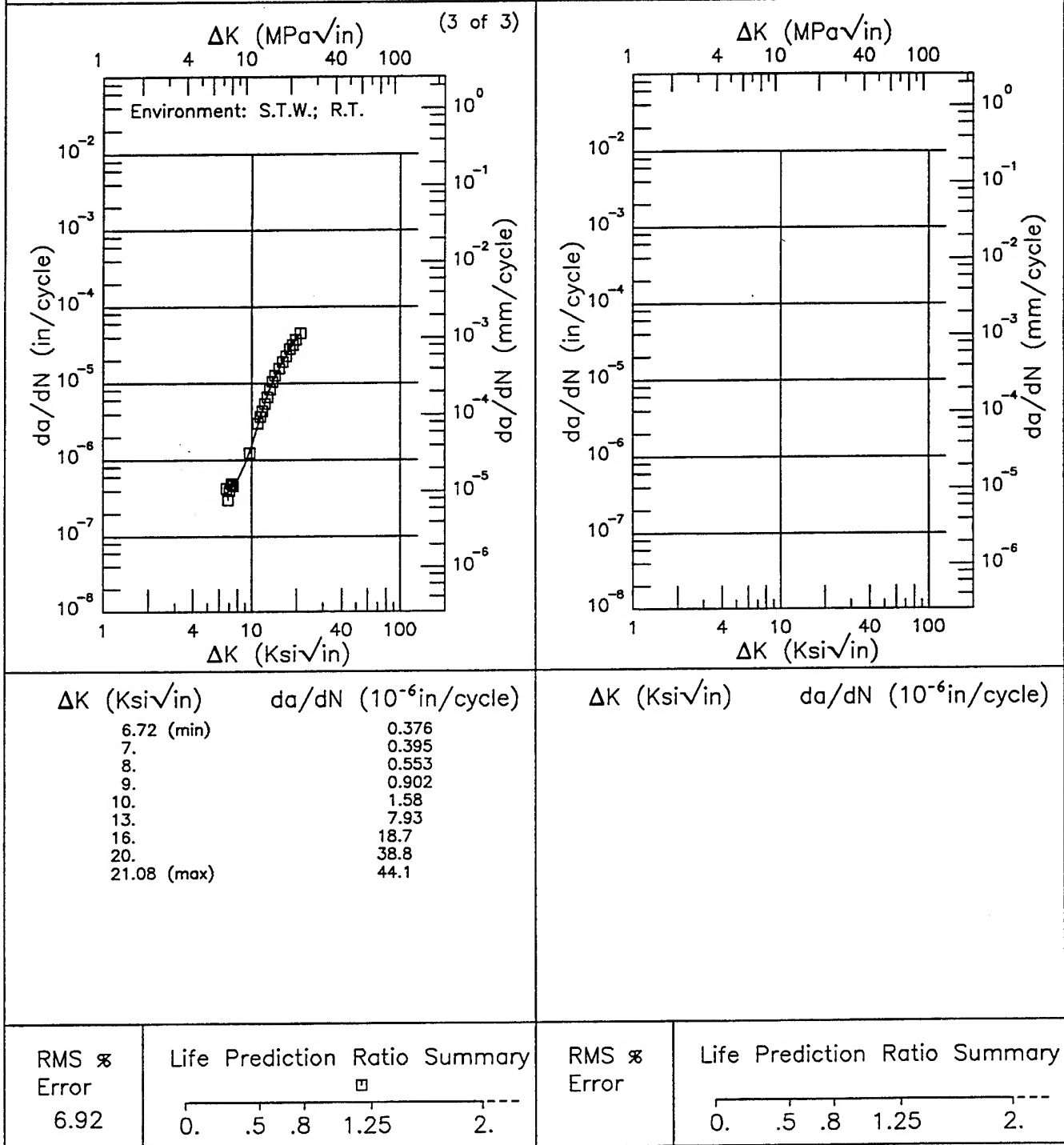
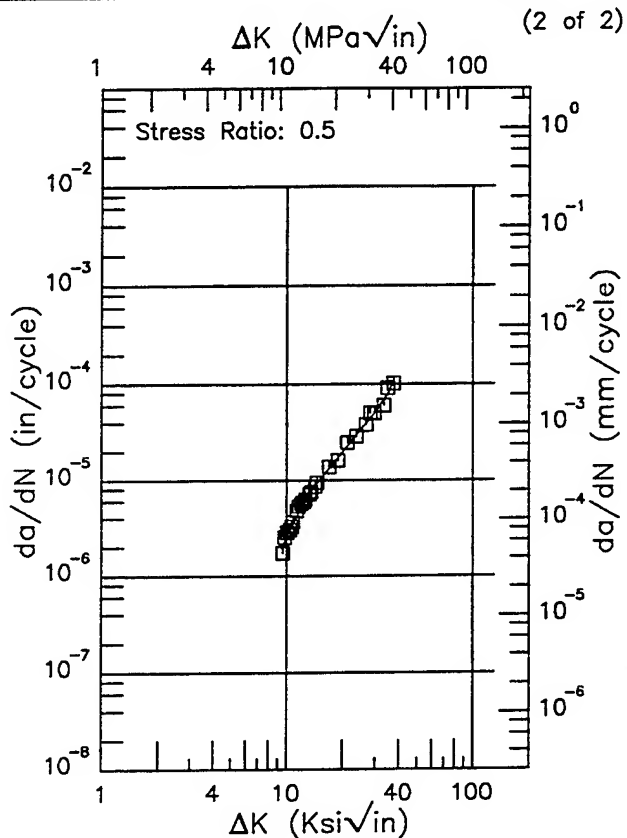
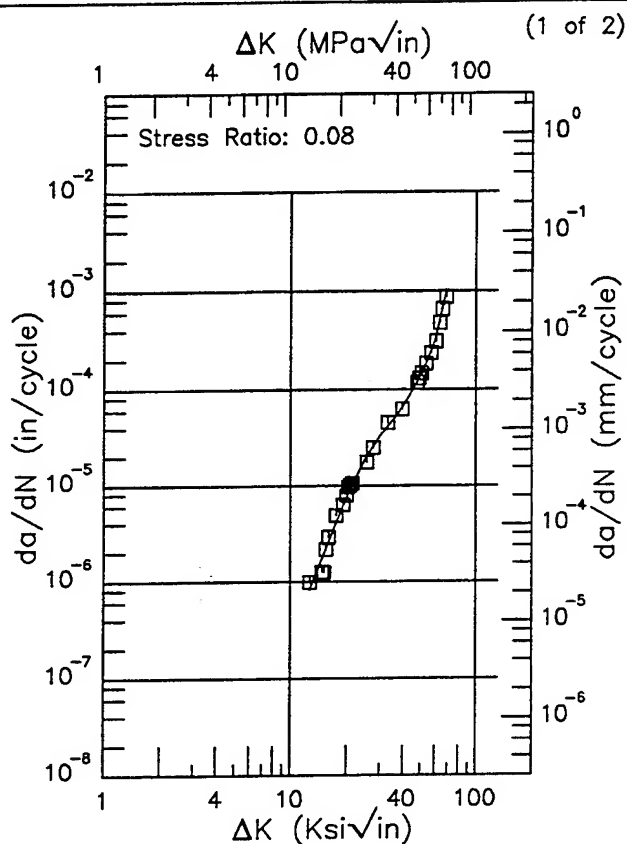


Figure 6.16.3.1.121 (Concluded)

R Ti-6Al-4V  
 Condition/Ht: RA  
 Form: 4 in. Forging  
 Specimen Type: CT  
 Orientation: T-L  
 Frequency: 6 Hz  
 Environment: DRY AIR; RT

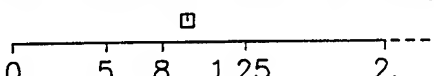
Yield Strength: 119 - 128 ksi  
 Ult. Strength: 127 - 136 ksi  
 Specimen Thk: 1 in.  
 Specimen Width: 7.4 in.  
 Ref: 88579



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
12.73 (min)	0.819
13.	0.908
16.	2.57
20.	7.57
25.	19.0
30.	33.0
35.	47.9
40.	66.7
50.	137.
60.	317.
68.69 (max)	940.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
9.49 (min)	1.98
10.	2.62
13.	6.93
16.	11.5
20.	19.7
25.	33.7
30.	51.2
35.	79.7
37.30 (max)	105.

RMS %  
 Error  
 13.14

Life Prediction Ratio Summary  


RMS %  
 Error  
 7.98

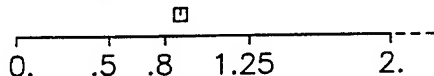
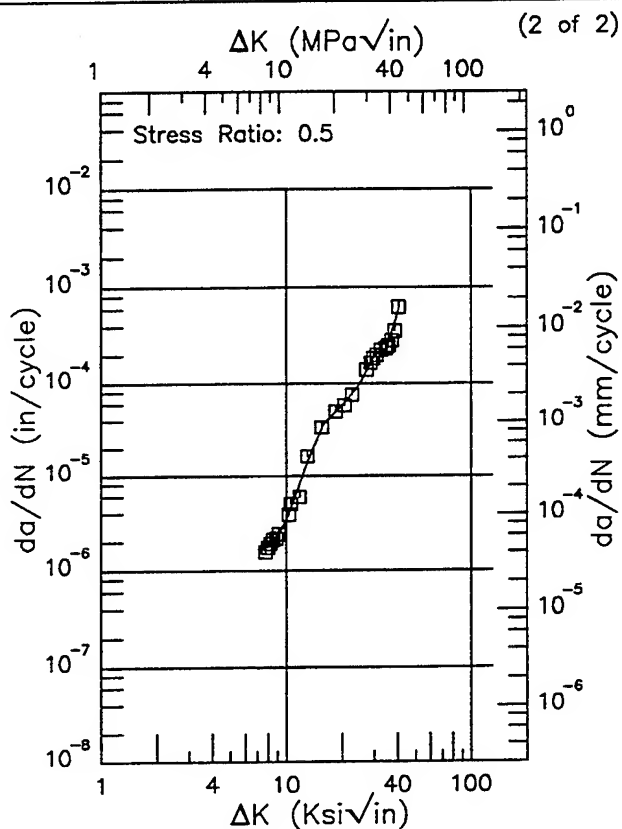
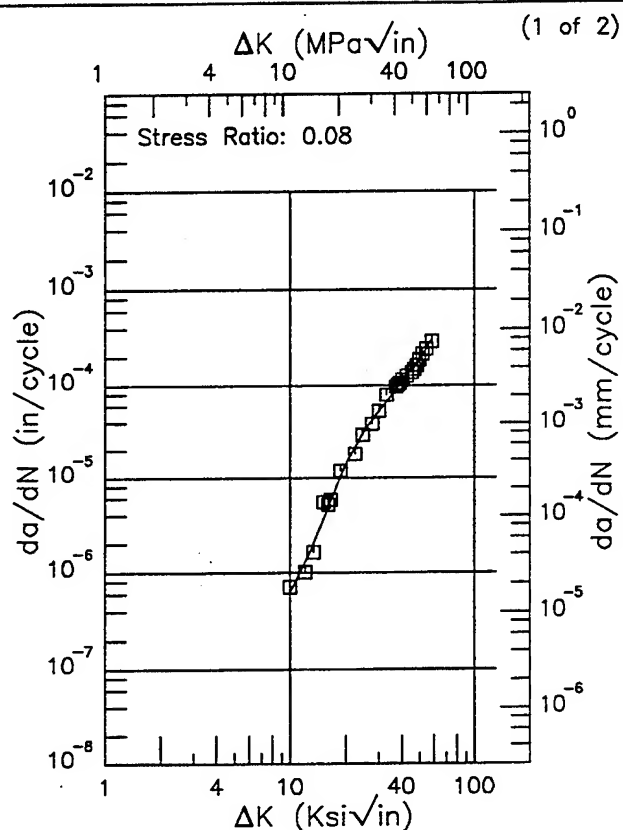
Life Prediction Ratio Summary  


Figure 6.16.3.1.122

Condition/Ht: RA  
Form: 4 in. Forging  
Specimen Type: CT  
Orientation: T-L  
Frequency: 1 Hz  
Environment: S.T.W.; RT

Yield Strength: 128 ksi  
Ult. Strength: 136 ksi  
Specimen Thk: 0.66 - 0.77 in.  
Specimen Width: 7.4 in.  
Ref: 88579



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
9.95 (min)	0.610
10.	0.619
13.	1.74
16.	4.87
20.	14.2
25.	32.2
30.	52.4
35.	77.7
40.	111.
50.	185.
58.05 (max)	303.

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
7.69 (min)	1.78
8.	1.78
9.	2.25
10.	3.41
13.	14.3
16.	36.9
20.	58.0
25.	98.6
30.	196.
35.	238.
40.	539.
40.43 (max)	628.

RMS %  
Error  
13.38

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

RMS %  
Error  
9.35

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

Figure 6.16.3.1.123



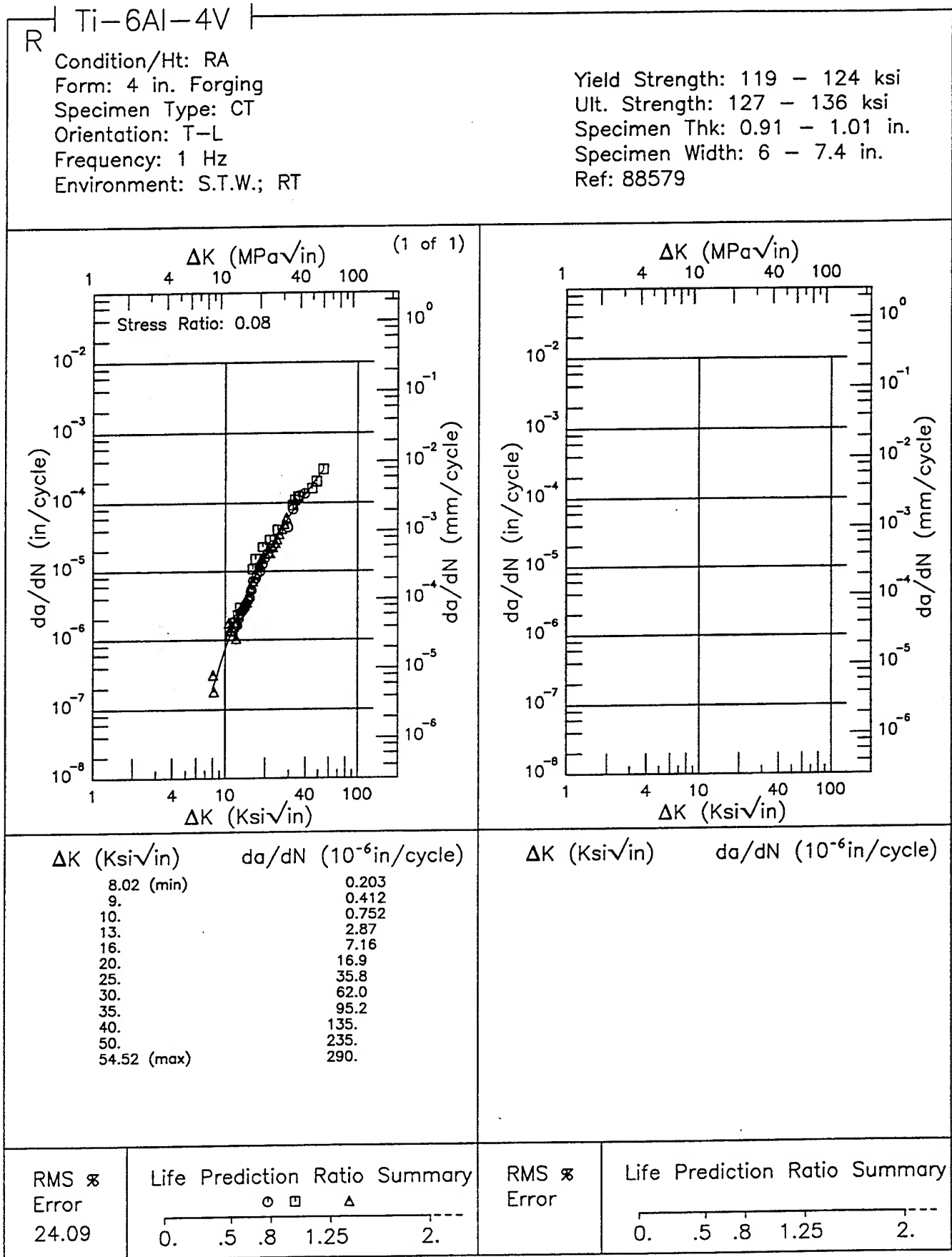


Figure 6.16.3.1.124

Condition/Ht: RA(FAST COOLED)

Form: 1 in. Plate

Specimen Type: DCB

Orientation: T-L

Stress Ratio: 0.1

Frequency: 1 Hz

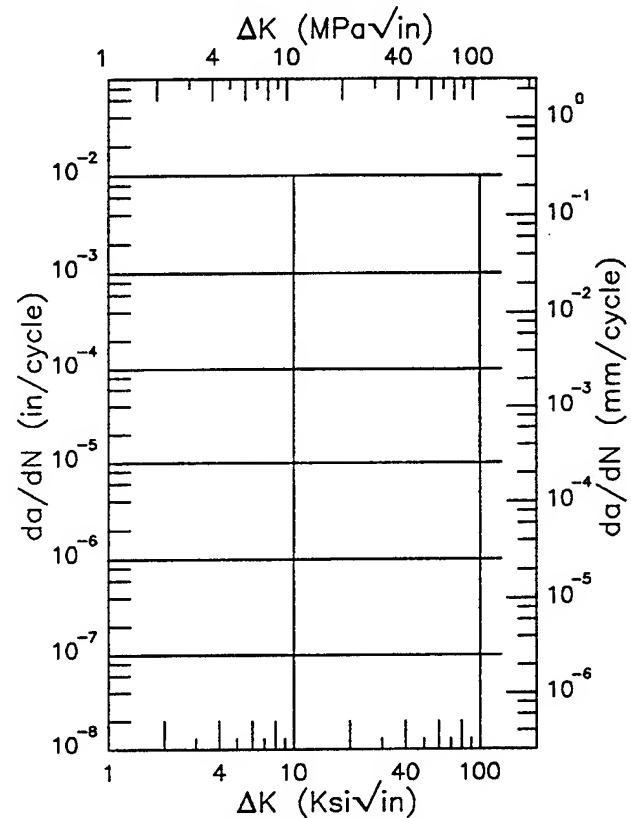
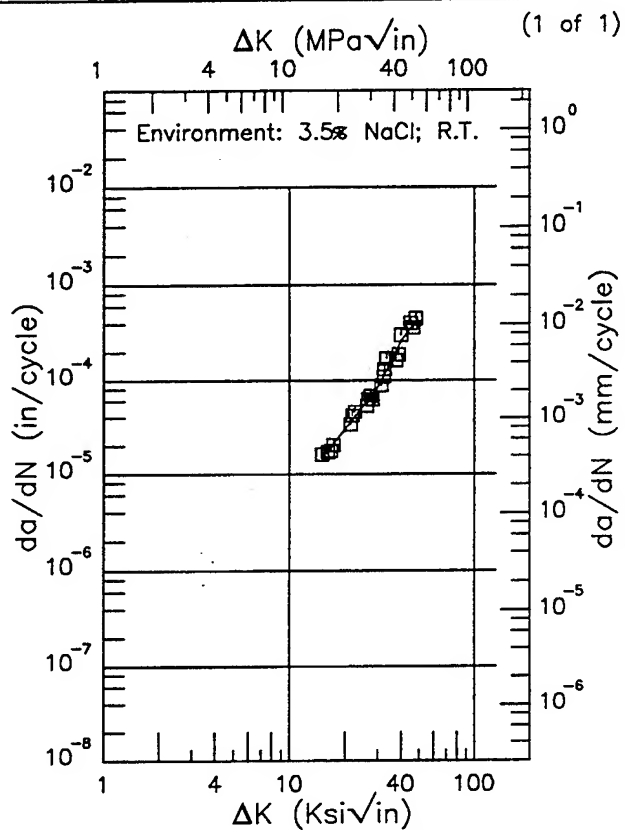
Yield Strength:

Ult. Strength:

Specimen Thk:

Specimen Width:

Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
14.96 (min)	15.2
16.	17.2
20.	29.7
25.	52.4
30.	84.0
35.	151.
40.	265.
47.90 (max)	420.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
--------------------------------------	-------------------------------

RMS %  
Error  
13.11

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

RMS %  
Error

Life Prediction Ratio Summary

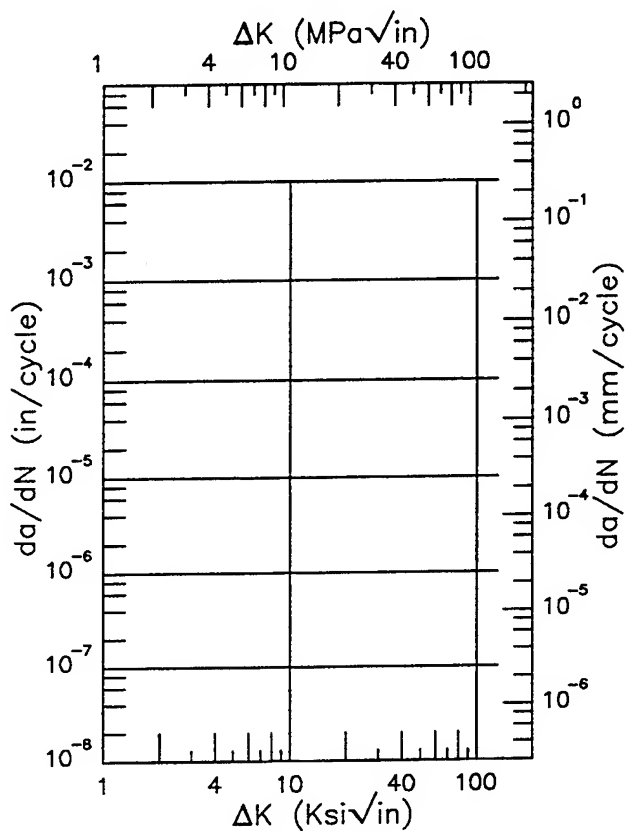
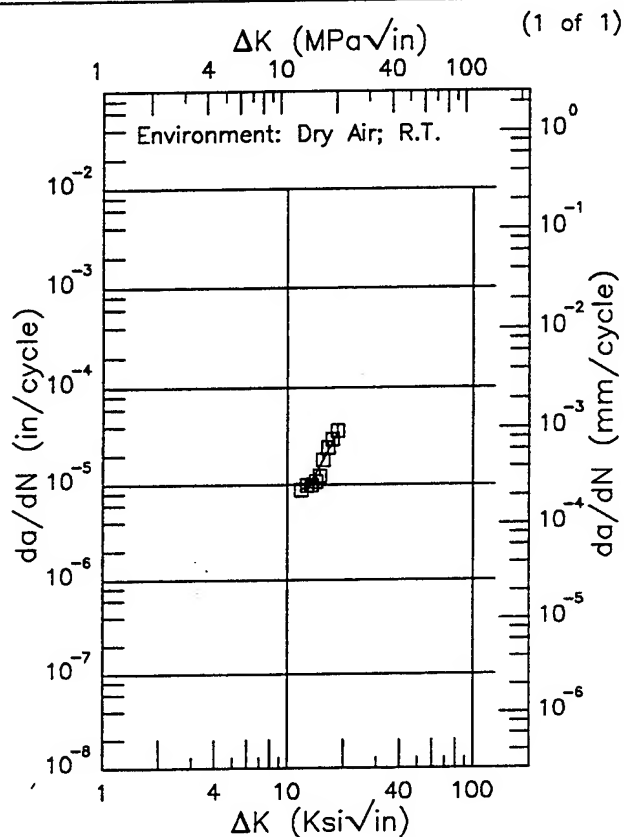
0. .5 .8 1.25 2. ---

Figure 6.16.3.1.125

E | Ti-6Al-4V |

Condition/Ht: STOA  
 Form: 0.62 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.3  
 Frequency: 1 Hz

Yield Strength: 140 ksi  
 Ult. Strength: 150 ksi  
 Specimen Thk: 0.491 in.  
 Specimen Width: 6 in.  
 Ref: 85837



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
11.82 (min)	8.99
13.	9.53
16.	20.1
18.56 (max)	35.0

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS  $\times$   
 Error  
 10.07

Life Prediction Ratio Summary  
  
 0. .5 .8 1.25 2.

RMS  $\times$   
 Error

Life Prediction Ratio Summary  
  
 0. .5 .8 1.25 2.

Figure 6.16.3.1.126

Condition/Ht: STRESS RELIEVED E.B. WELDMENT (HAZ)

Form: Weldment

Specimen Type: CT

Orientation: T-L

Stress Ratio: 0.1

Environment: LAB AIR; -65°F

Yield Strength:

Ult. Strength:

Specimen Thk: 1 in.

Specimen Width: 2.55 in.

Ref: 88144

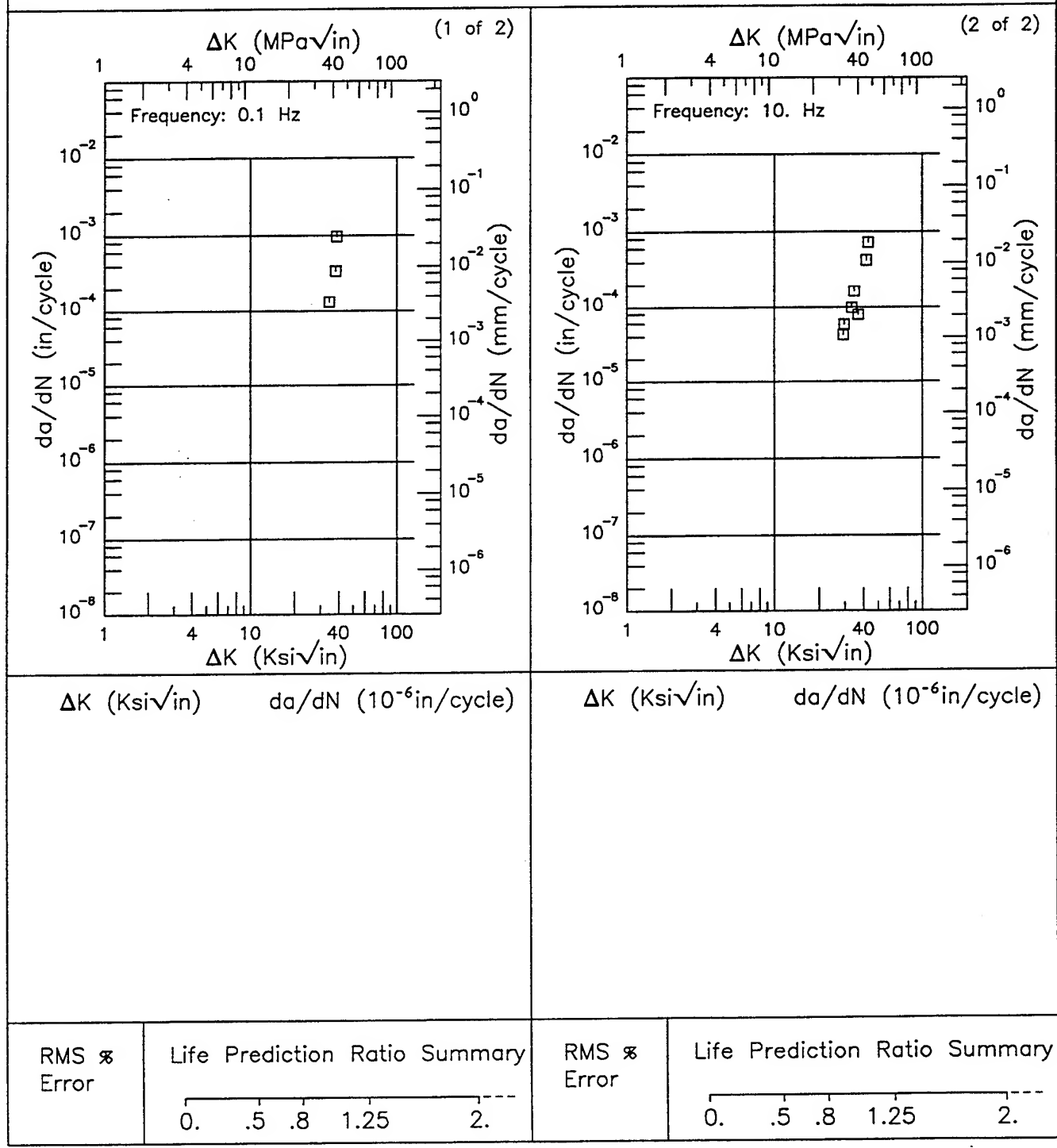


Figure 6.16.3.1.127

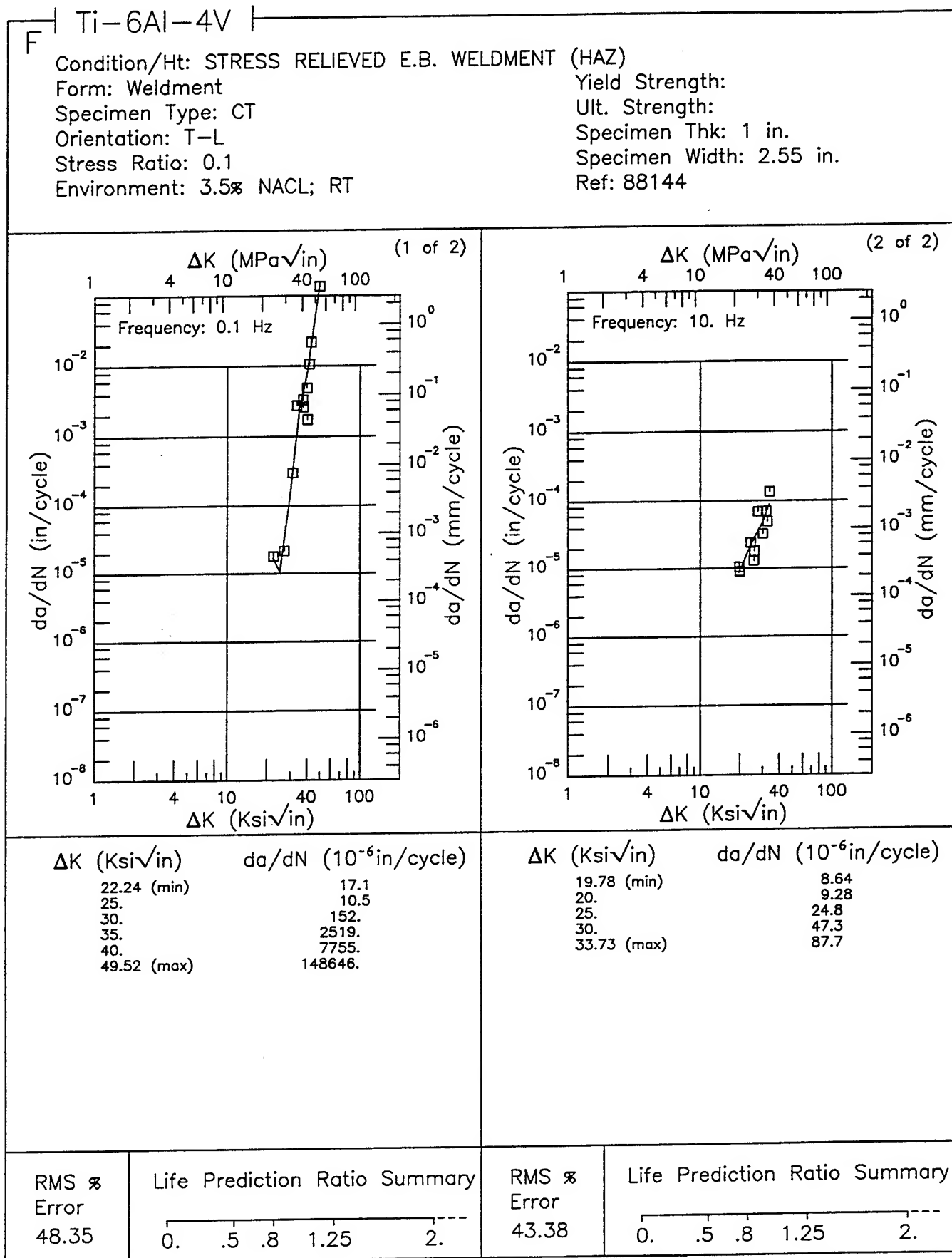


Figure 6.16.3.1.128

Condition/Ht: STRESS RELIEVED E.B. WELDMENT (HAZ)

Form: Weldment

Specimen Type: CT

Orientation: T-L

Stress Ratio: 0.1

Environment: JP4; RT

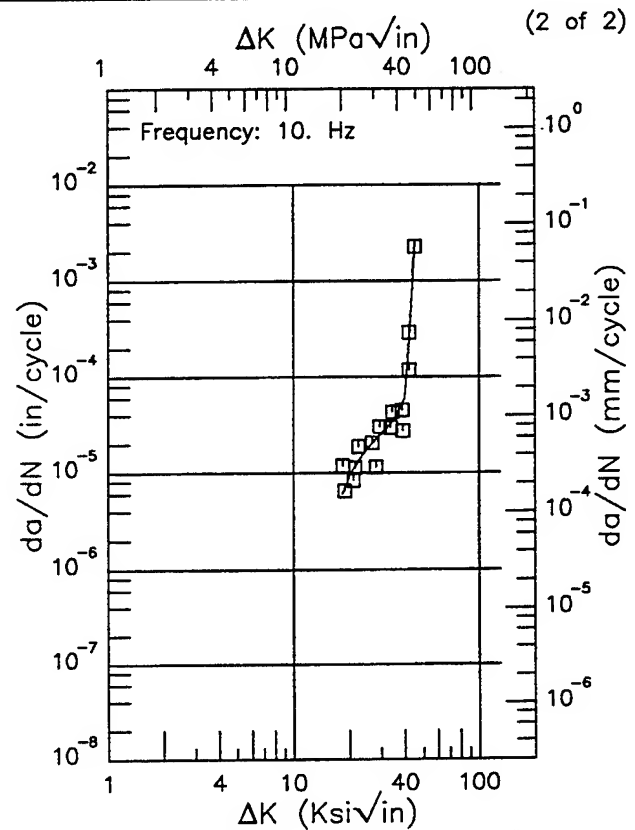
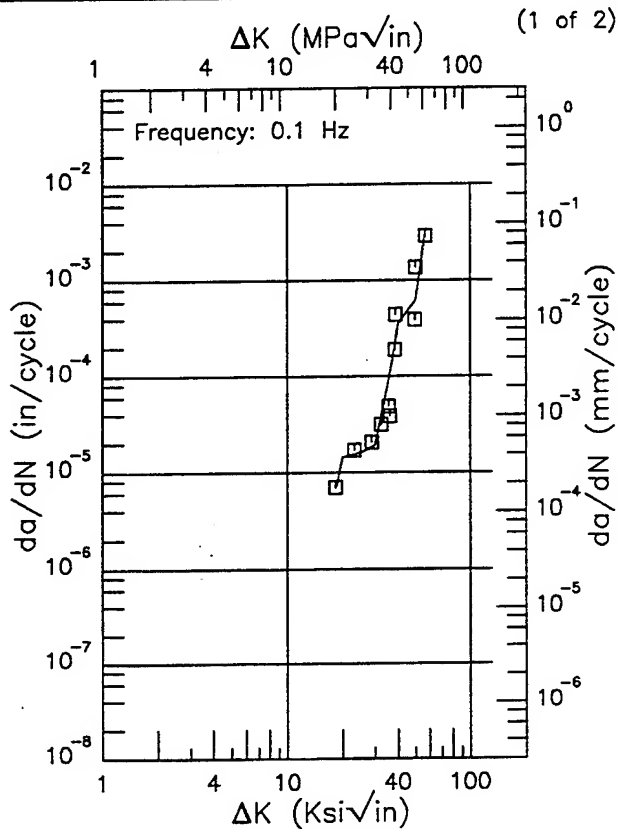
Yield Strength:

Ult. Strength:

Specimen Thk: 1 in.

Specimen Width: 2.55 in.

Ref: 88144

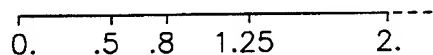


$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
18.23 (min)	6.87
20.	14.6
25.	16.1
30.	19.1
35.	80.1
40.	358.
50.	621.
56.28 (max)	2893.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
18.39 (min)	6.05
20.	9.36
25.	17.8
30.	25.7
35.	35.2
40.	60.6
45.20 (max)	2543.

RMS %  
Error  
51.87

Life Prediction Ratio Summary



RMS %  
Error  
37.44

Life Prediction Ratio Summary

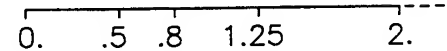


Figure 6.16.3.1.129

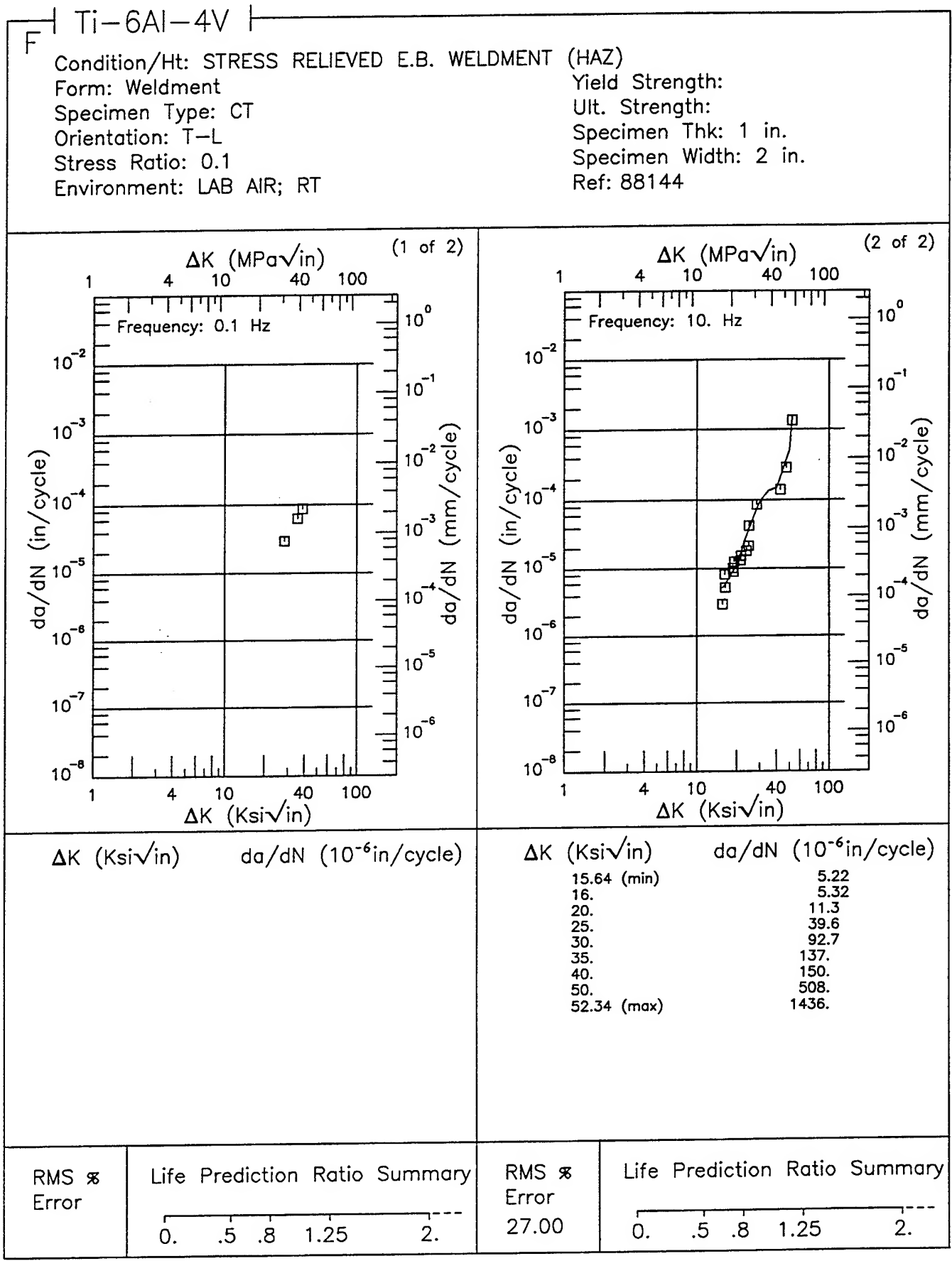


Figure 6.16.3.1.130

Condition/Ht: STRESS RELIEVED E.B. WELDMENT (HAZ)

Form: Weldment

Specimen Type: CT

Orientation: T-L

Stress Ratio: 0.1

Environment: 3.5% NACL;175°F

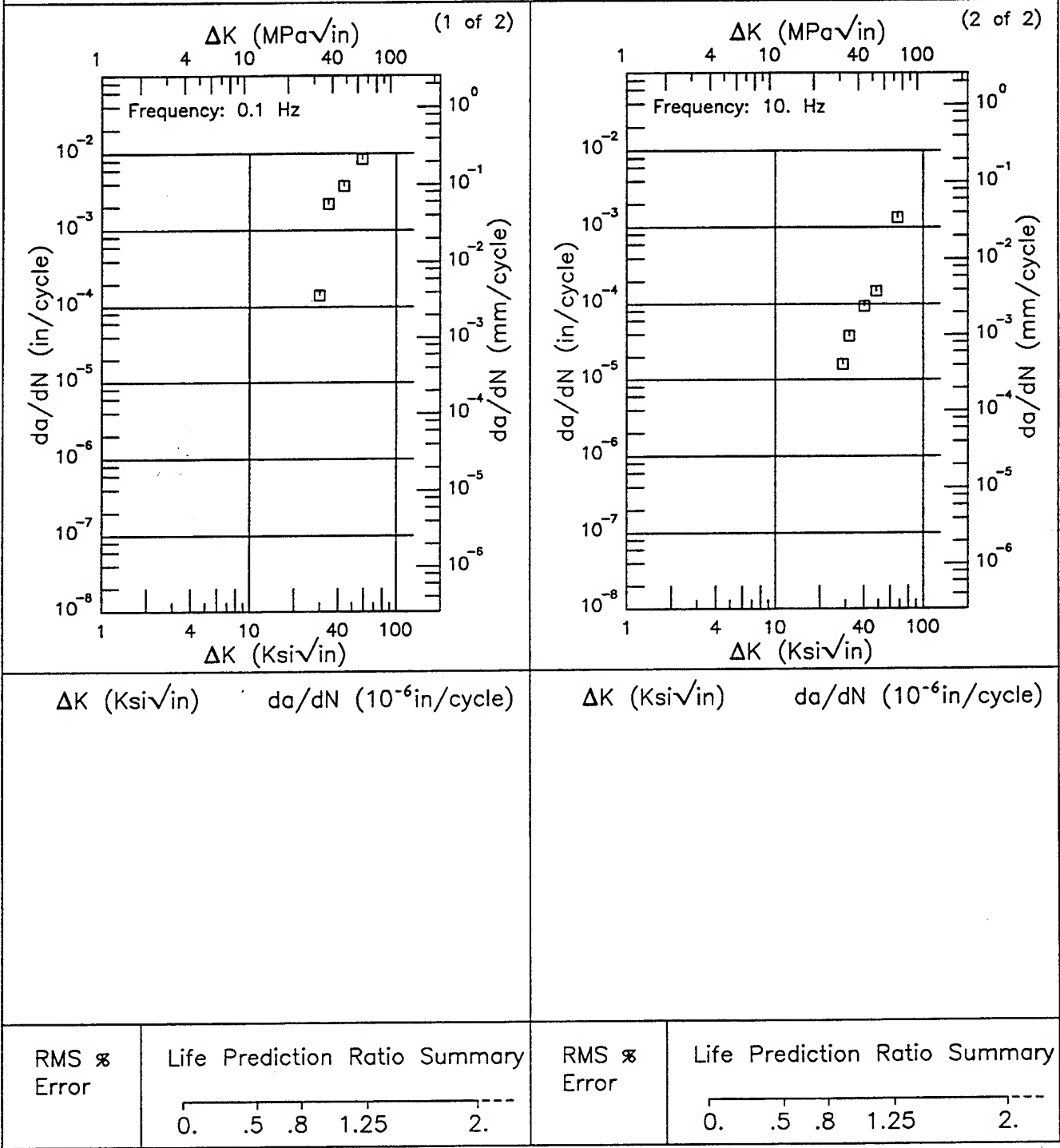
Yield Strength:

Ult. Strength:

Specimen Thk: 1 in.

Specimen Width: 2.55 in.

Ref: 88144





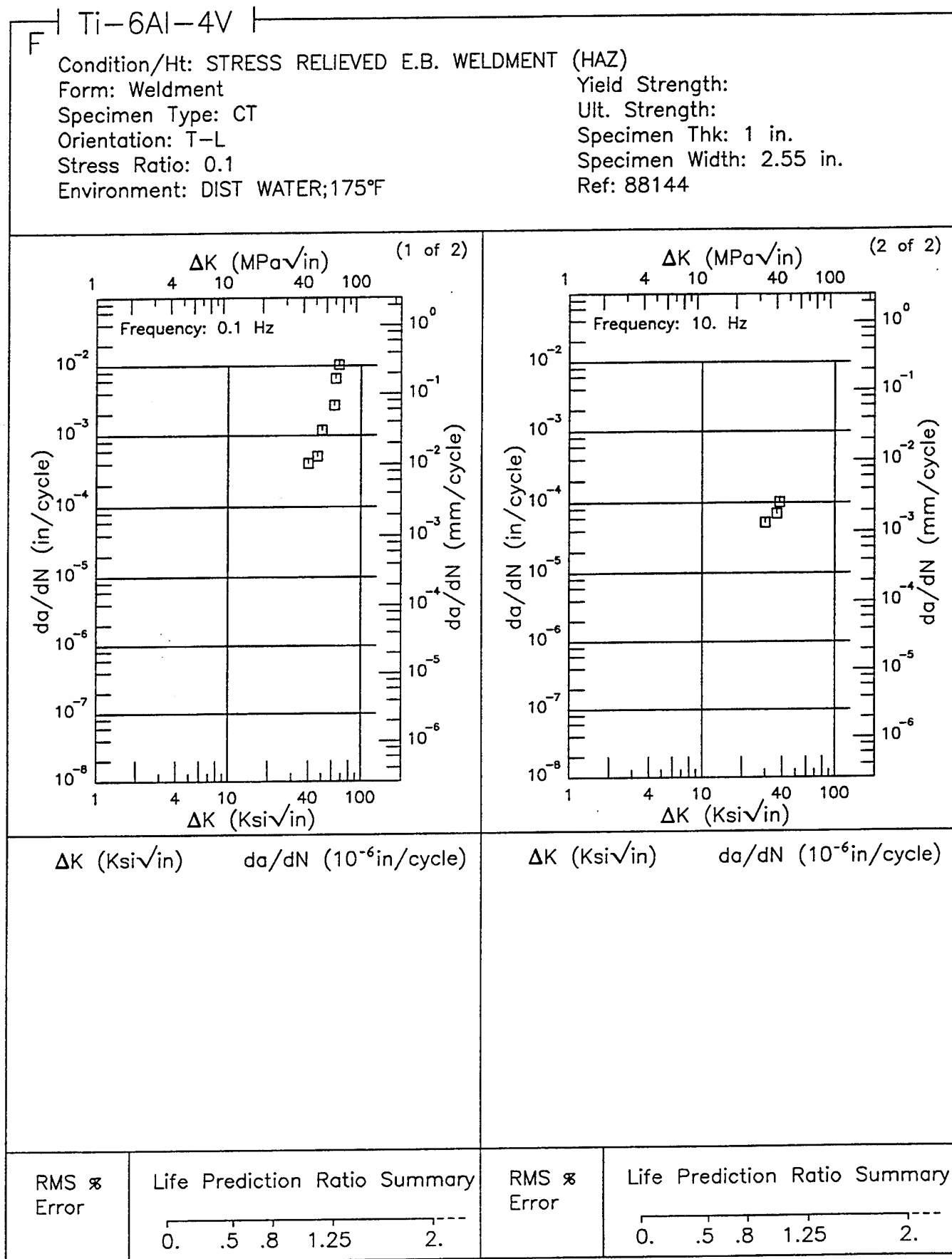


Figure 6.16.3.1.132

Condition/Ht: STRESS RELIEVED E.B. WELDMENT (HAZ)

Form: Weldment

Specimen Type: CT

Orientation: T-L

Stress Ratio: 0.1

Environment: LAB AIR;175°F

Yield Strength:

Ult. Strength:

Specimen Thk: 1 in.

Specimen Width: 2.55 in.

Ref: 88144

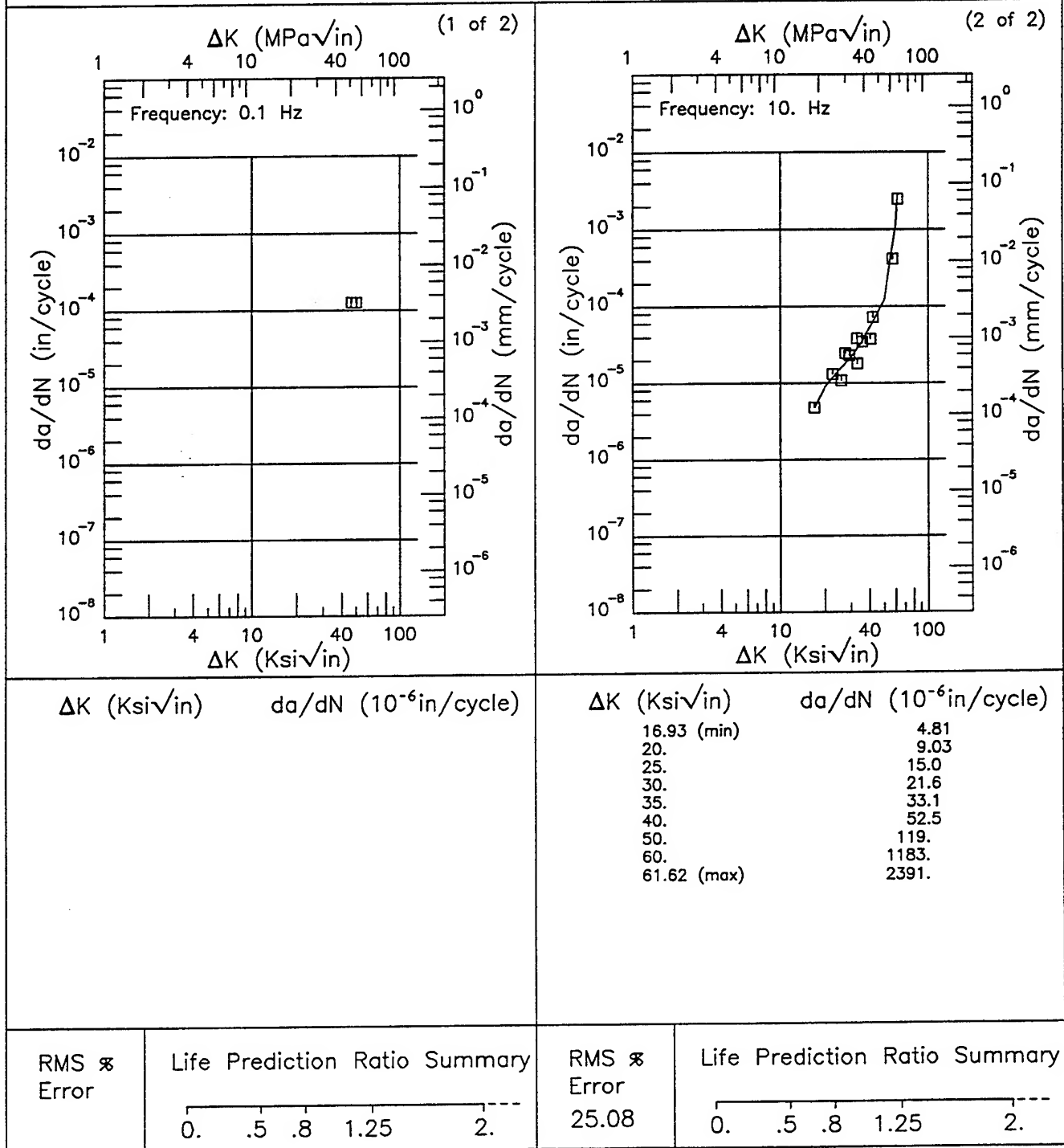


Figure 6.16.3.1.133

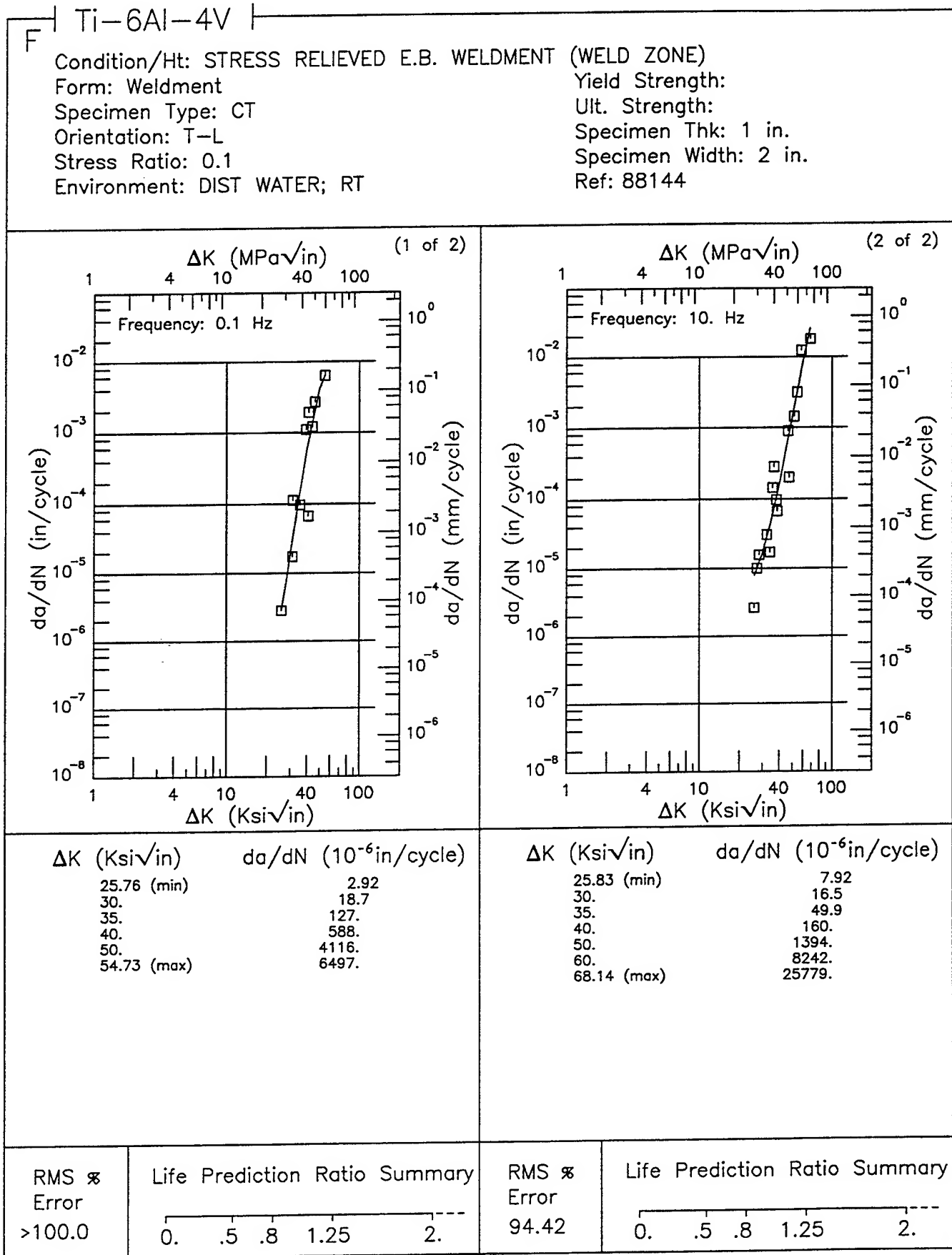


Figure 6.16.3.1.134

Ti-6Al-4V

F

Condition/Ht: STRESS RELIEVED E.B. WELDMENT (WELD ZONE)

Form: Weldment

Specimen Type: CT

Orientation: T-L

Stress Ratio: 0.1

Environment: LAB AIR; RT

Yield Strength:

Ult. Strength:

Specimen Thk: 1 in.

Specimen Width: 2 in.

Ref: 88144

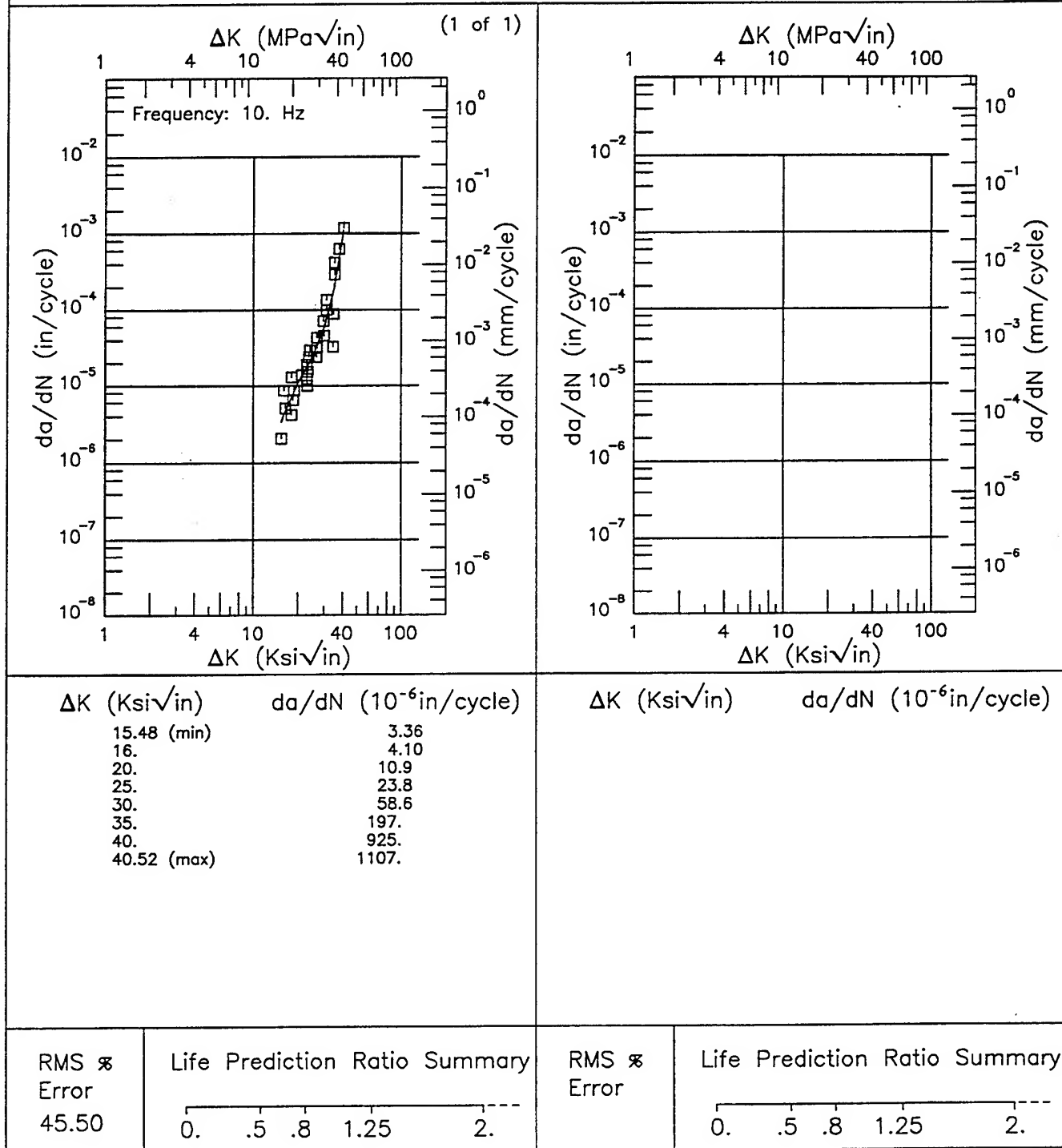


Figure 6.16.3.1.135

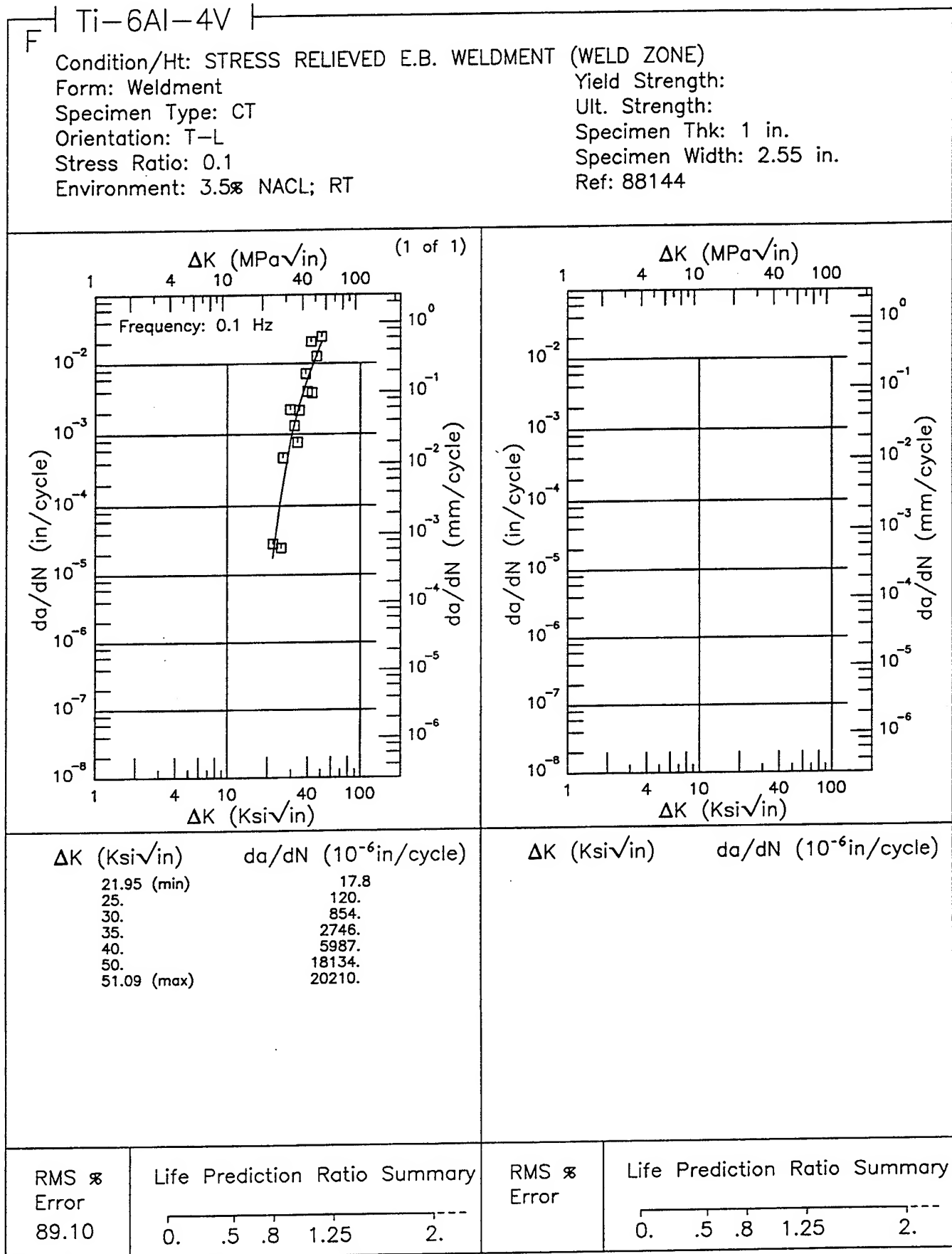


Figure 6.16.3.1.136

Condition/Ht: STRESS RELIEVED E.B. WELDMENT (WELD ZONE)

Form: Weldment

Specimen Type: CT

Orientation: T-L

Stress Ratio: 0.1

Environment: 3.5% NaCl; 175°F

Yield Strength:

Ult. Strength:

Specimen Thk: 1 in.

Specimen Width: 2.55 in.

Ref: 88144

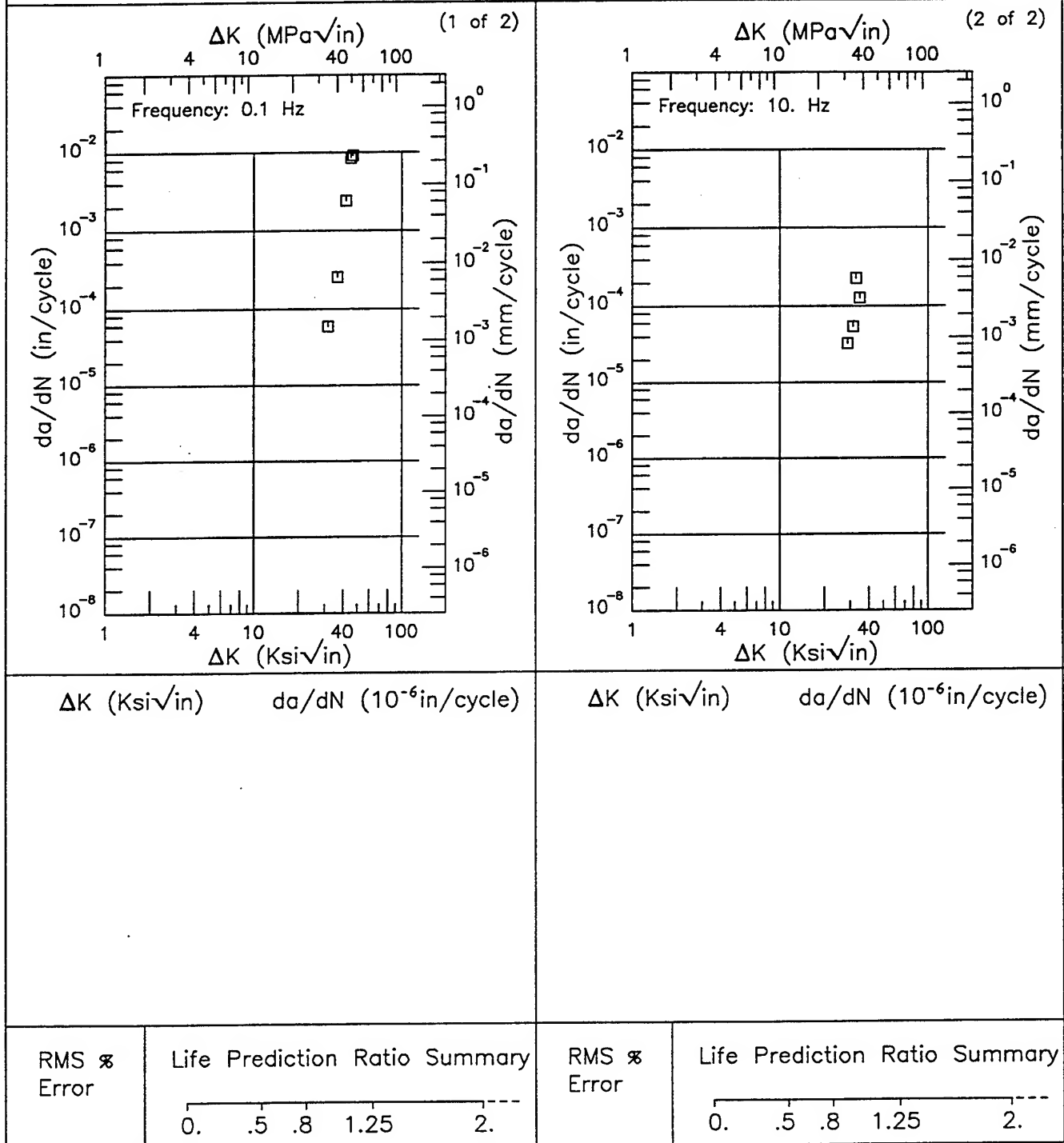


Figure 6.16.3.1.137

Ti-6Al-4V

Condition/Ht: 1000F 2HR

Form: 2 in. Forging

Specimen Type: TDCB

Orientation: L-T

Yield Strength: 145 ksi

Ult. Strength:

Specimen Thk: 1.25 in.

Specimen Width: 5.5 in.

Ao:

K<sub>Isc</sub>: 31 - 43 ksi

Ref: 84360

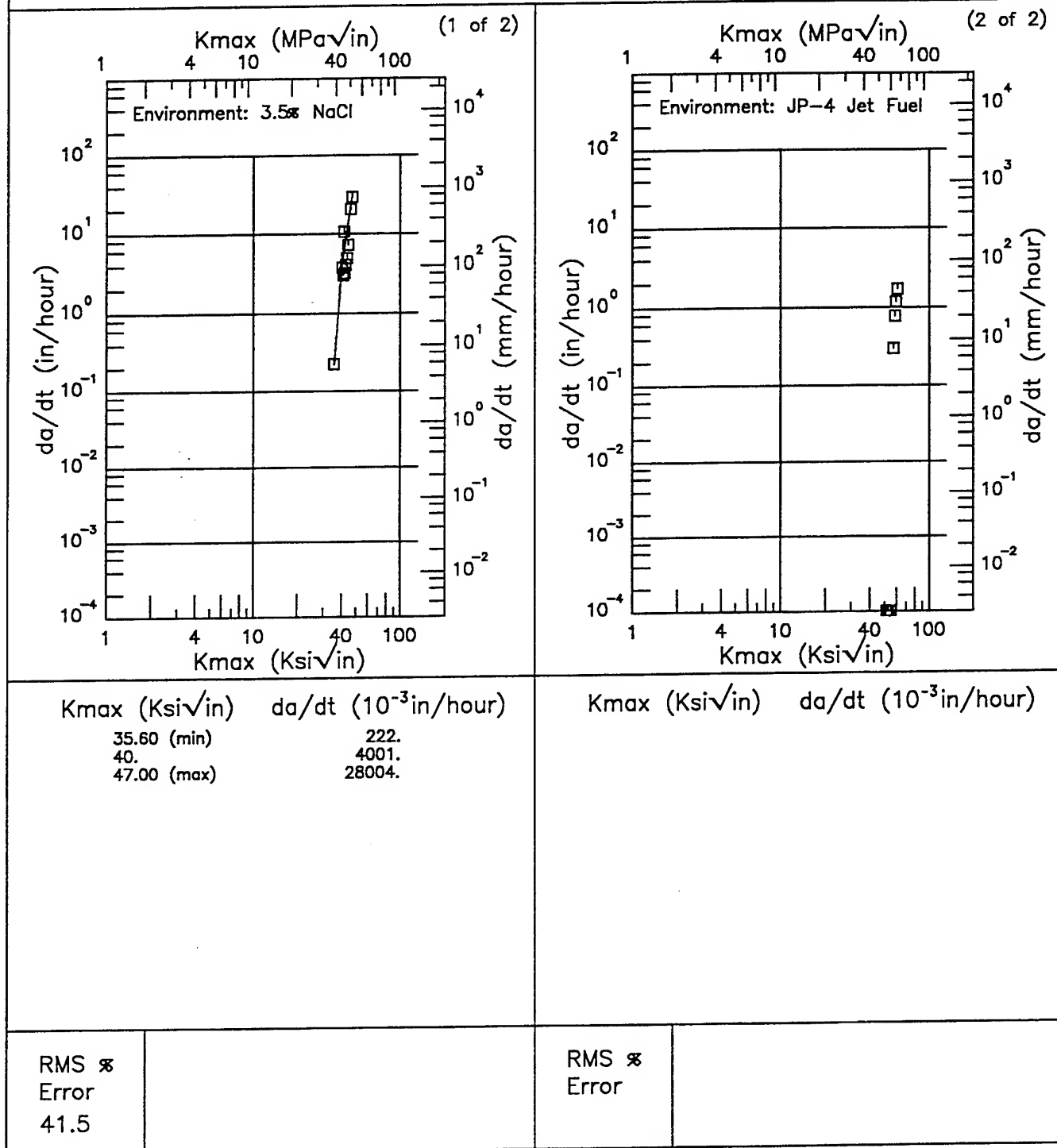


Figure 6.16.3.2.1

Condition/Ht: EB WELD STRESS RELIEVED (HEAT AFFECTED ZONE)

Form: Weldment

Specimen Type: CT

Orientation: T-L

Yield Strength: 132 ksi

Ult. Strength:

Specimen Thk: 1 in.

Specimen Width: 2.55 in.

Ao:

K<sub>Isc</sub>: 33 ksi

Ref: 88144

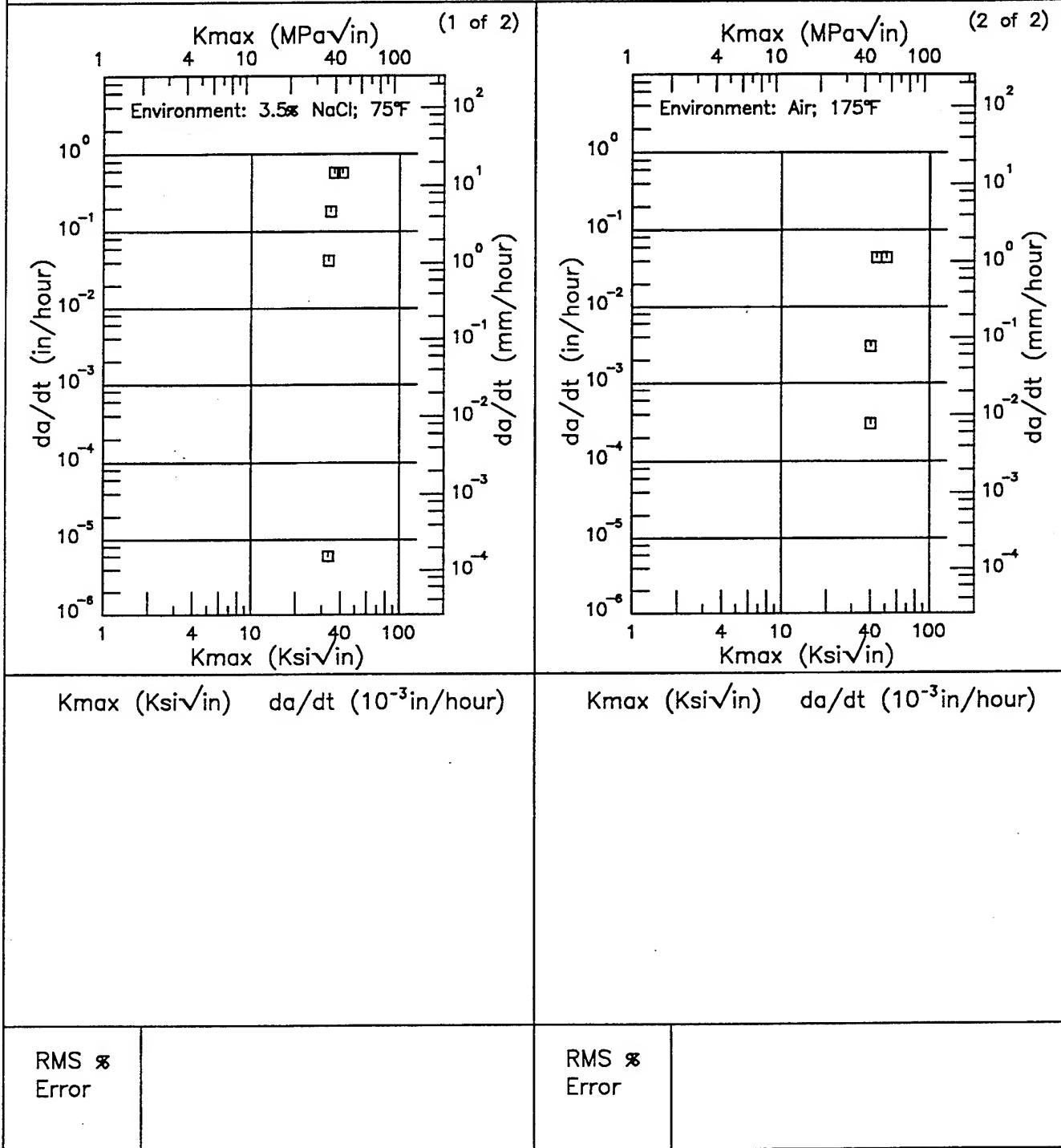


Figure 6.16.3.2.2



Ti-6Al-4V

Condition/Ht: EB WELD STRESS RELIEVED (WELD ZONE)

Form: Weldment

Specimen Type: CT

Orientation: T-L

Yield Strength: 132 ksi

Ult. Strength:

Specimen Thk: 1 in.

Specimen Width: 2.55 in.

Ao:

K<sub>Isc</sub>: 36 - 51.5 ksi

Ref: 88144

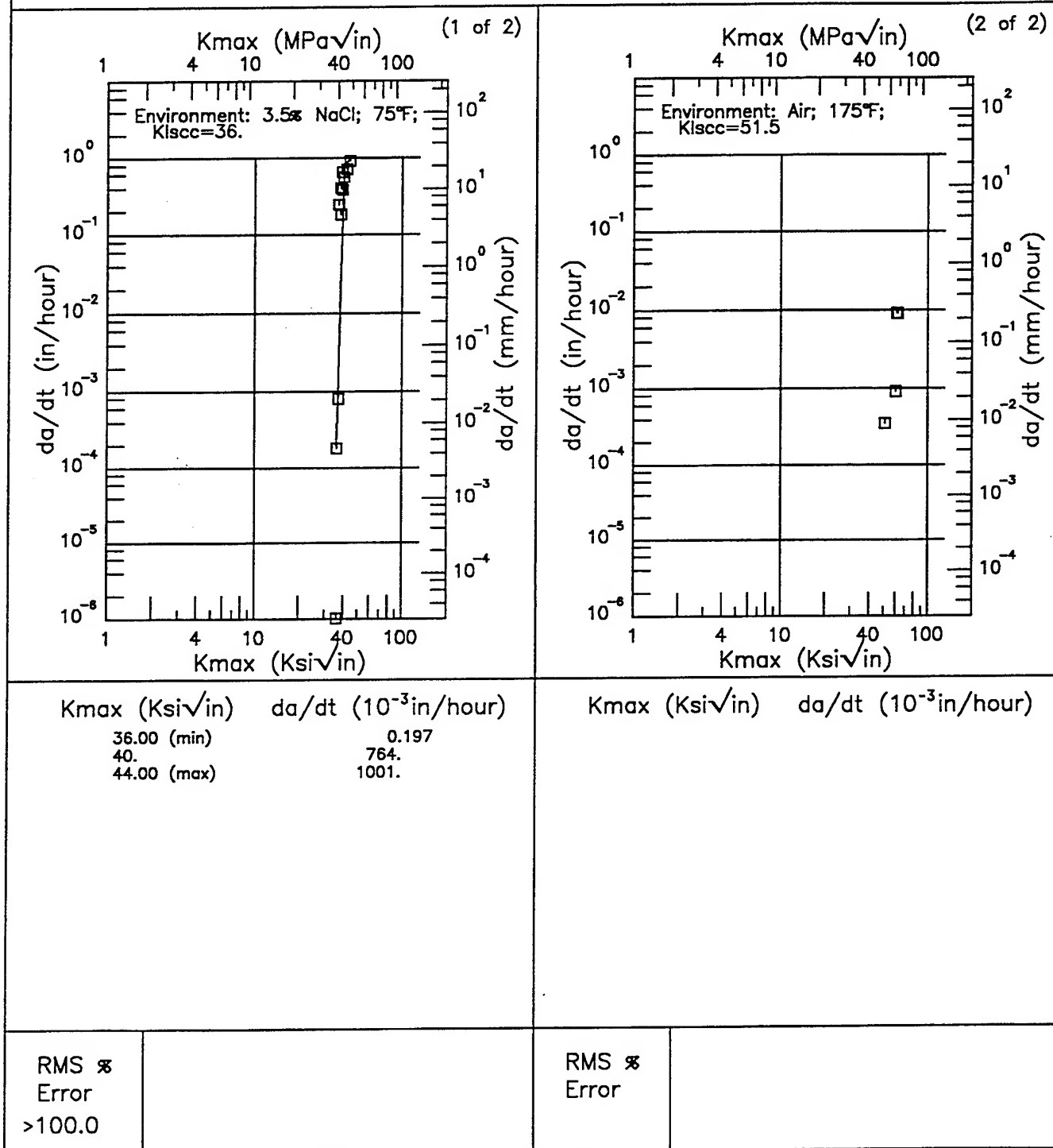


Figure 6.16.3.2.3

Condition/Ht: MA  
 Form: 0.2 in. Sheet  
 Specimen Type: DCB  
 Orientation: T-L  
 Yield Strength:  
 Ult. Strength:

Specimen Thk: 0.2 in.  
 Specimen Width:  
 A<sub>0</sub>:  
 K<sub>Isc</sub>:  
 Ref: 81221

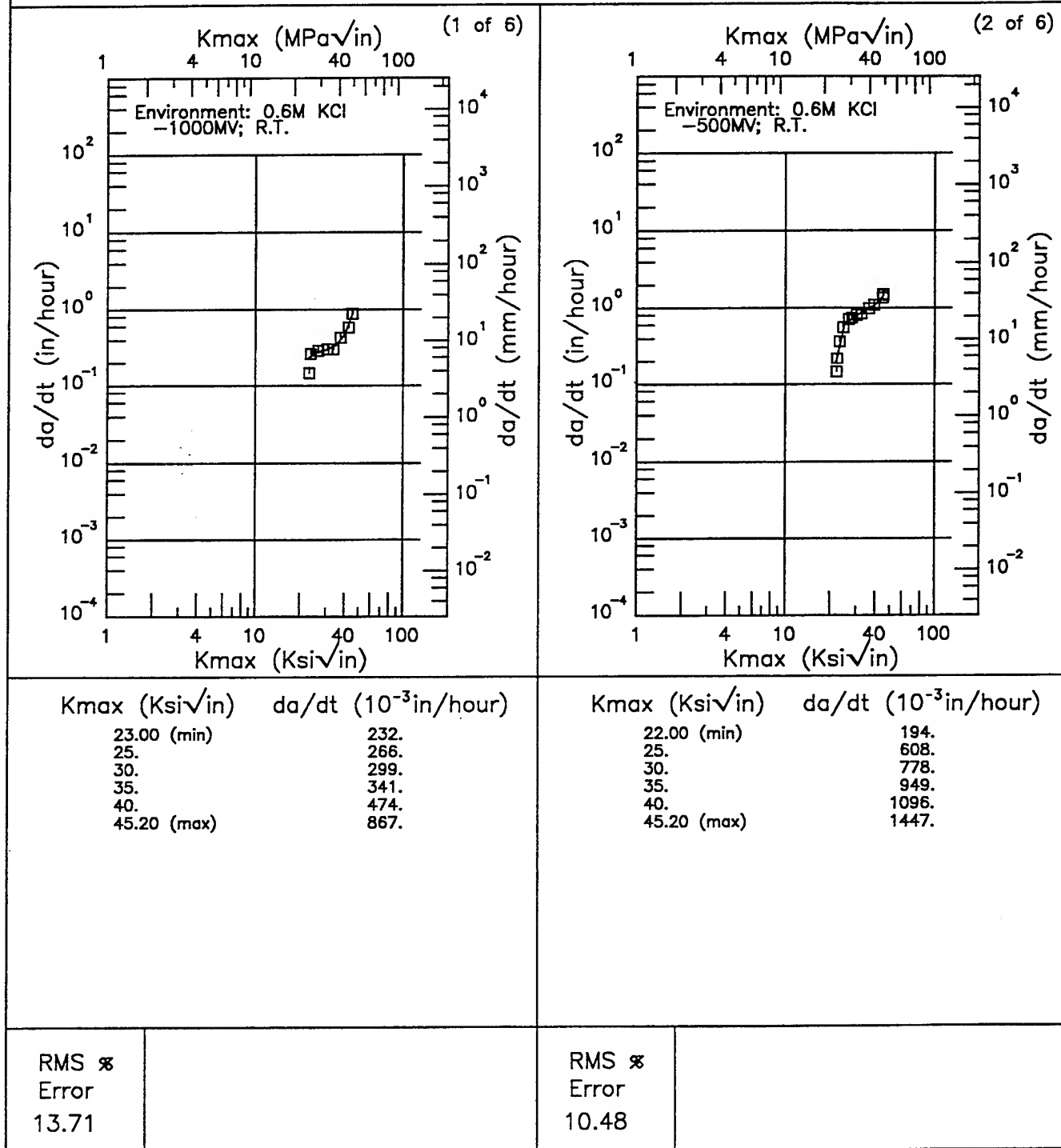
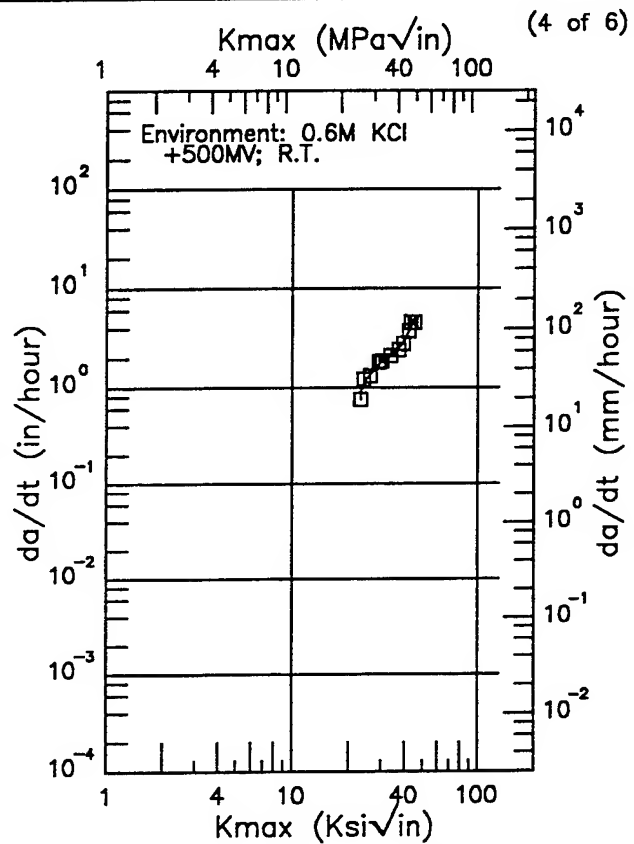
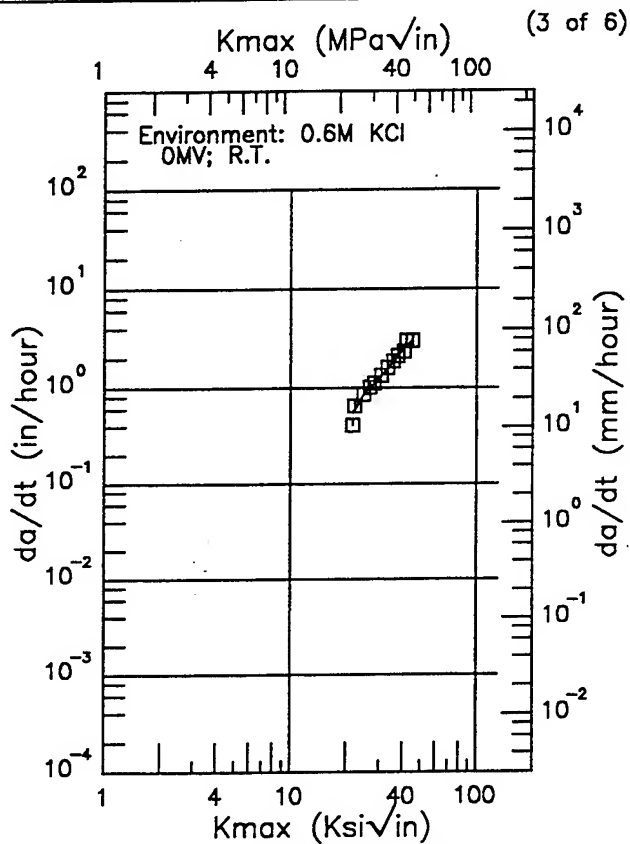


Figure 6.16.3.2.4

Ti-6Al-4V

Condition/Ht: MA  
Form: 0.2 in. Sheet  
Specimen Type: DCB  
Orientation: T-L  
Yield Strength:  
Ult. Strength:

Specimen Thk: 0.2 in.  
Specimen Width:  
A<sub>0</sub>:  
K<sub>I</sub>SCC:  
Ref: 81221



Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
21.50 (min)	549.
25.	898.
30.	1264.
35.	1785.
40.	2470.
45.00 (max)	3072.

Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
23.00 (min)	882.
25.	1236.
30.	1823.
35.	2242.
40.	3027.
45.20 (max)	5110.

RMS %  
Error  
8.74

RMS %  
Error  
8.28

Figure 6.16.3.2.4 (Continued)

Condition/Ht: MA  
 Form: 0.2 in. Sheet  
 Specimen Type: DCB  
 Orientation: T-L  
 Yield Strength:  
 Ult. Strength:

Specimen Thk: 0.2 in.  
 Specimen Width:  
 $A_0$ :  
 $K_{Isc}$ :  
 Ref: 81221

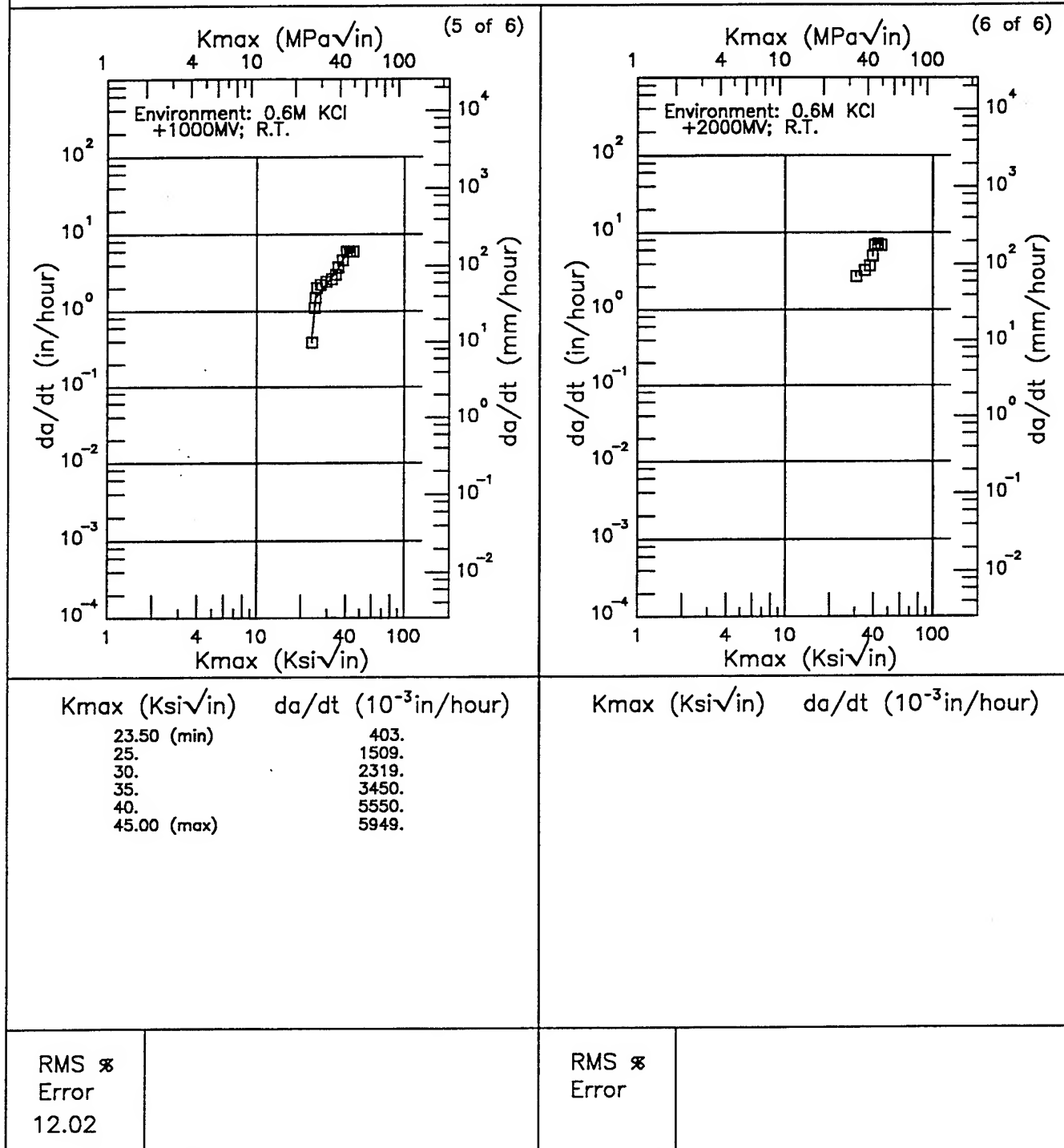


Figure 6.16.3.2.4 (Concluded)

Ti-6Al-4V

Condition/Ht: MA  
Form: 0.2 in. Sheet  
Specimen Type: DCB  
Orientation: T-L  
Yield Strength:  
Ult. Strength:

Specimen Thk: 0.2 in.  
Specimen Width:  
 $A_0$ :  
 $K_{Isc}$ : 35 ksi  
Ref: 81221

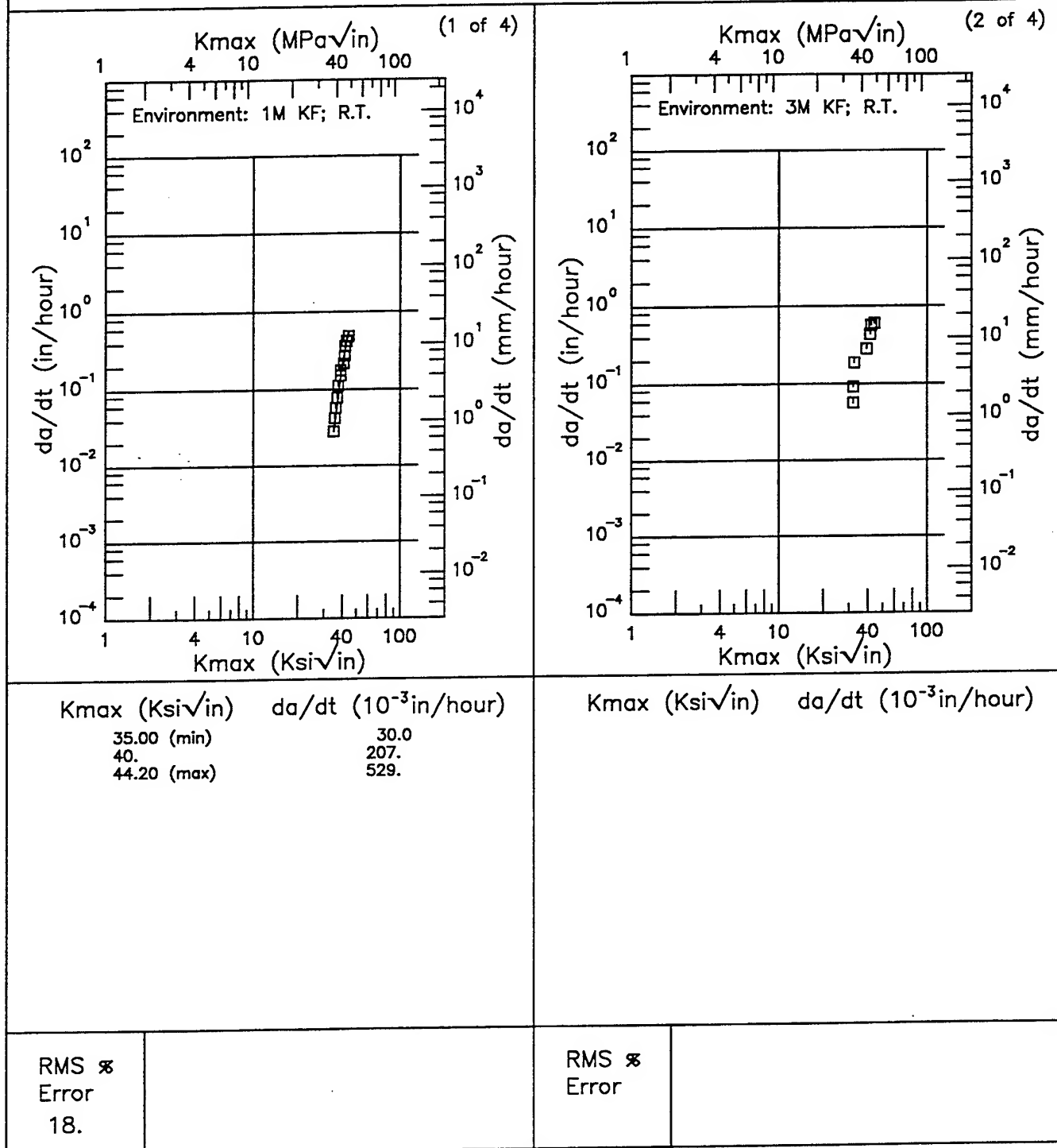


Figure 6.16.3.2.5

Condition/Ht: MA  
 Form: 0.2 in. Sheet  
 Specimen Type: DCB  
 Orientation: T-L  
 Yield Strength:  
 Ult. Strength:

Specimen Thk: 0.2 in.  
 Specimen Width:  
 $A_0$ :  
 $K_{Isc}$ : 35 ksi  
 Ref: 81221

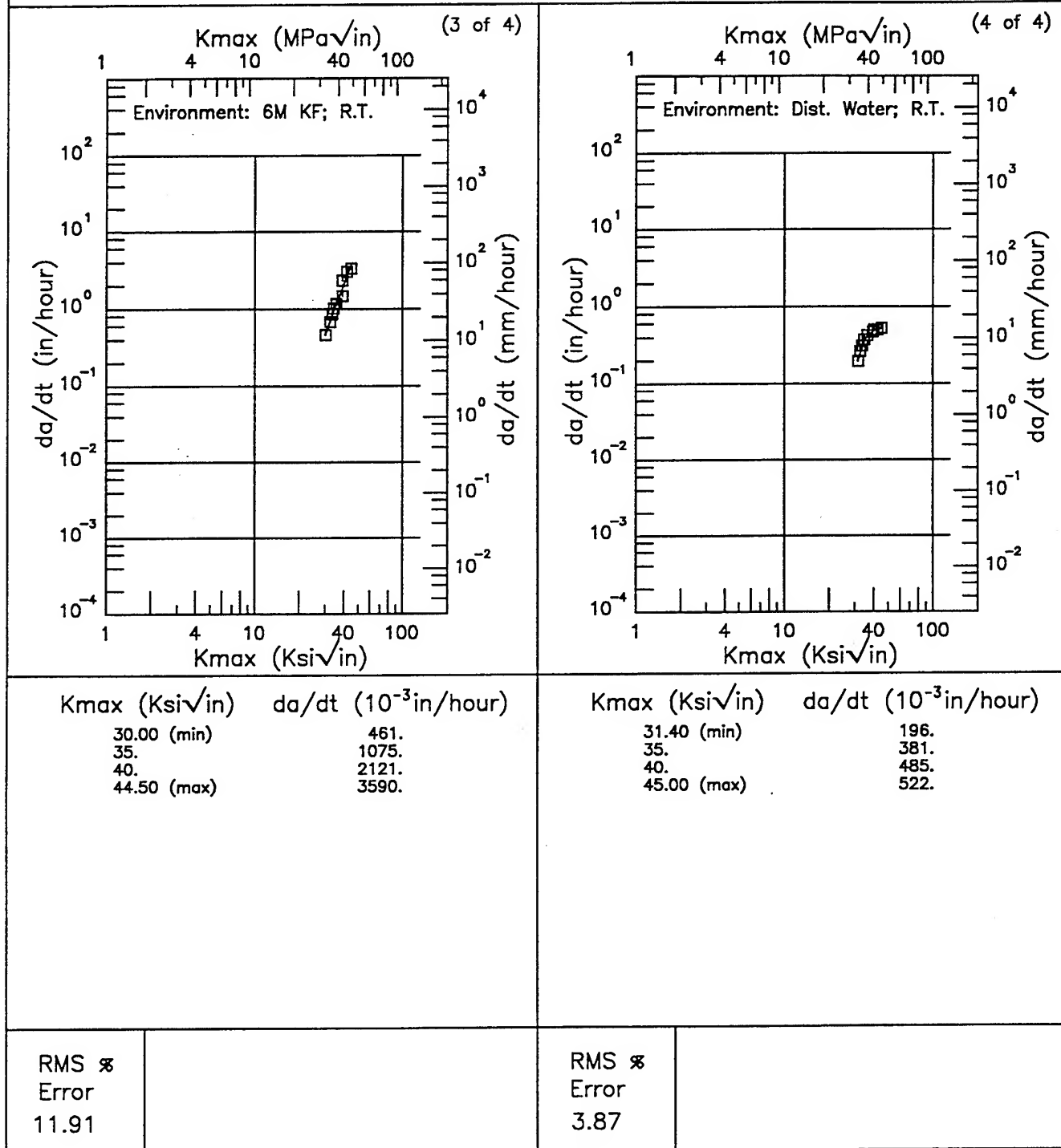


Figure 6.16.3.2.5 (Concluded)

Ti-6Al-4V

Condition/Ht: MA  
Form: 0.2 in. Sheet  
Specimen Type: DCB  
Orientation: T-L  
Yield Strength:  
Ult. Strength:

Specimen Thk: 0.2 in.  
Specimen Width:  
A<sub>0</sub>:  
K<sub>I</sub><sub>ISCC</sub>:  
Ref: 81221

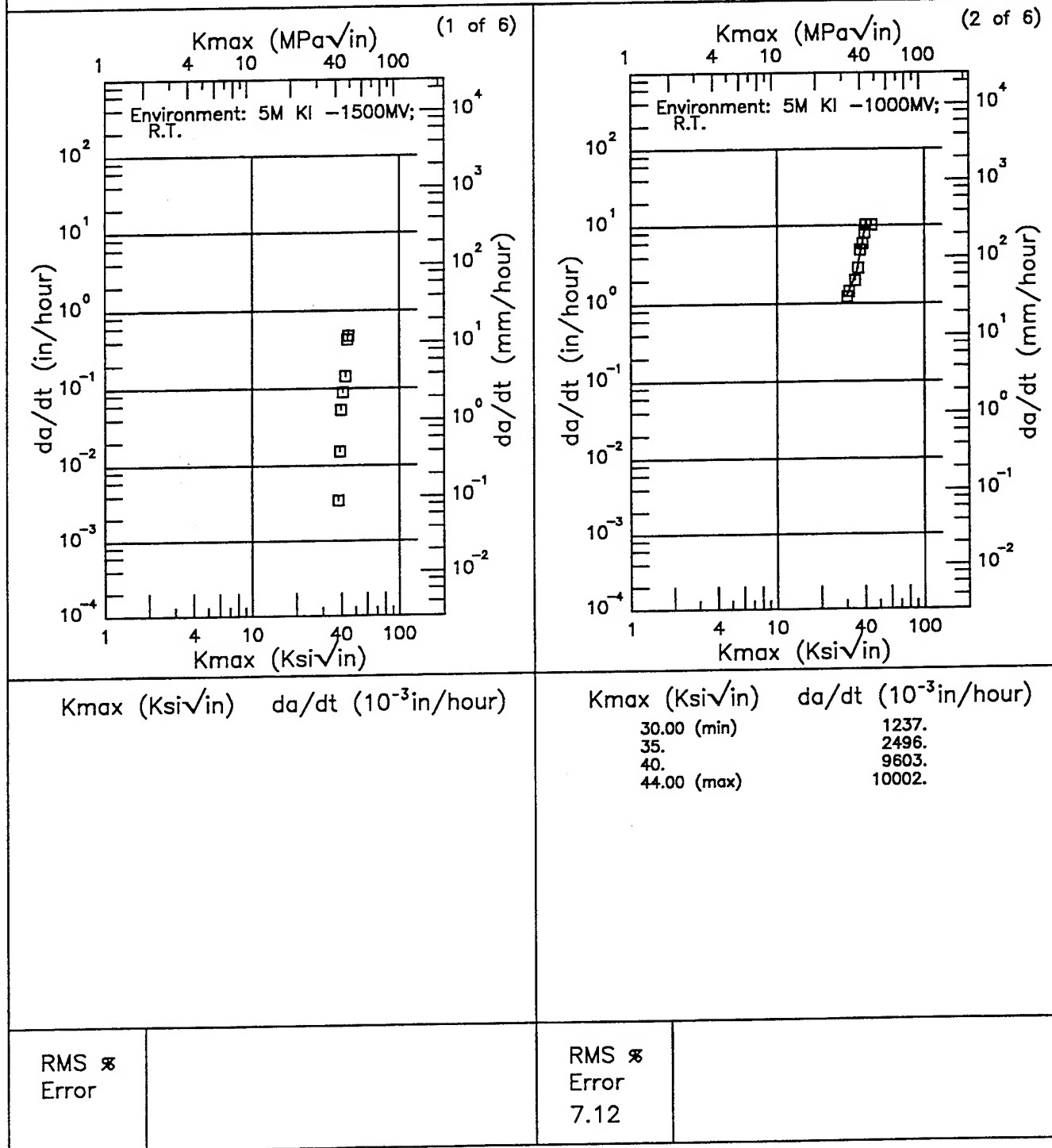
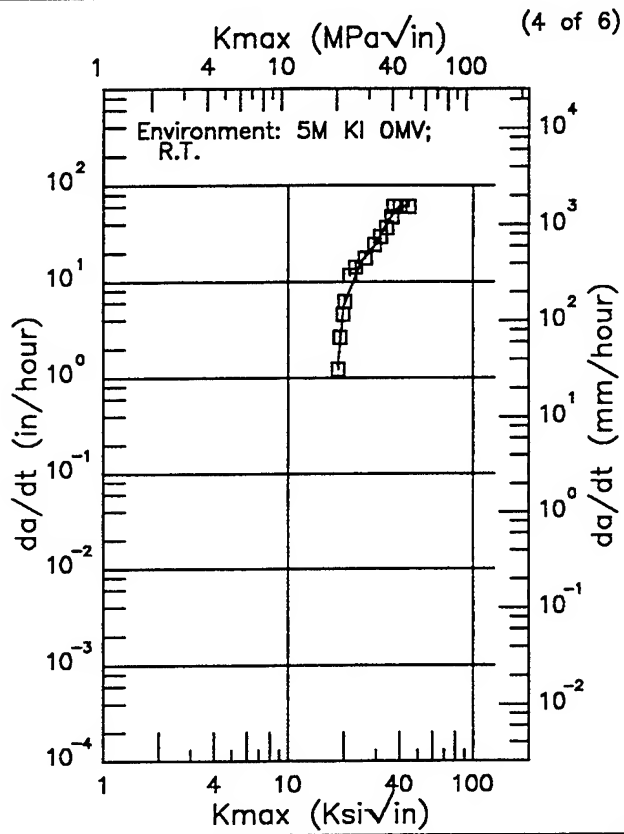
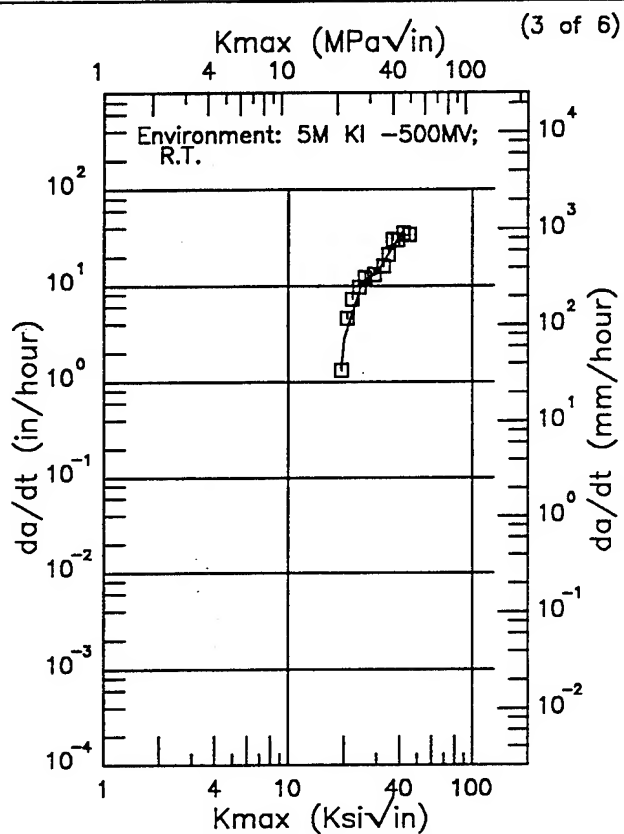


Figure 6.16.3.2.6

Condition/Ht: MA  
Form: 0.2 in. Sheet  
Specimen Type: DCB  
Orientation: T-L  
Yield Strength:  
Ult. Strength:

Specimen Thk: 0.2 in.  
Specimen Width:  
 $A_0$ :  
 $K_{Isc}$ :  
Ref: 81221



Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
19.20 (min)	1390.
20.	2779.
25.	11081.
30.	13644.
35.	22181.
40.	33262.
44.70 (max)	33578.

Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
18.50 (min)	1355.
20.	5587.
25.	16341.
30.	24942.
35.	44033.
40.	61104.
44.80 (max)	59957.

RMS %  
Error  
17.77

RMS %  
Error  
15.94

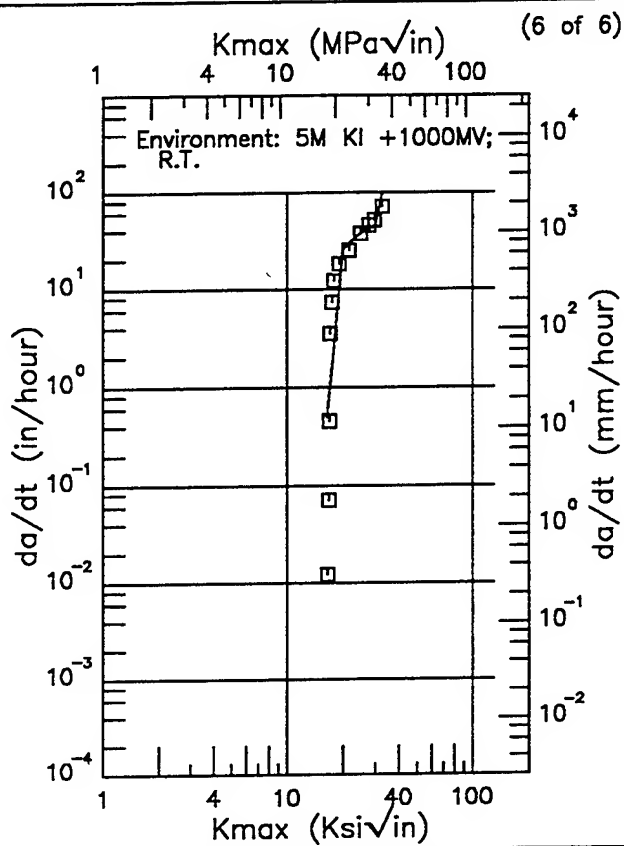
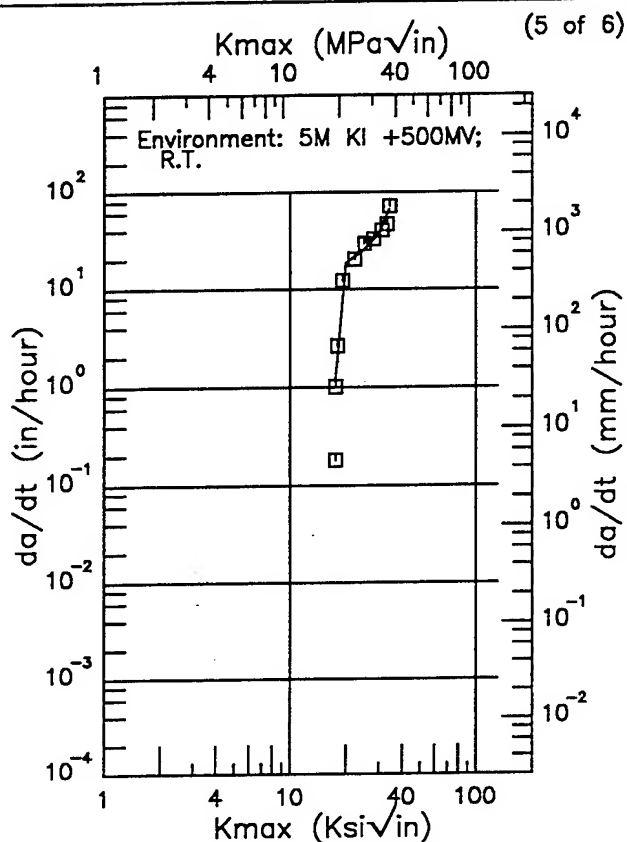
Figure 6.16.3.2.6 (Continued)



Ti-6Al-4V

Condition/Ht: MA  
Form: 0.2 in. Sheet  
Specimen Type: DCB  
Orientation: T-L  
Yield Strength:  
Ult. Strength:

Specimen Thk: 0.2 in.  
Specimen Width:  
Ao:  
K<sub>I</sub>SCC:  
Ref: 81221



$K_{max}$ (Ksi√in)	$da/dt$ ( $10^{-3}$ in/hour)
17.50 (min)	1161.
20.	18558.
25.	25355.
30.	36711.
34.00 (max)	66053.

$K_{max}$ (Ksi√in)	$da/dt$ ( $10^{-3}$ in/hour)
16.50 (min)	503.
20.	25954.
25.	37810.
30.	45074.
32.50 (max)	98475.

RMS %  
Error  
37.84

RMS %  
Error  
>100.0

Figure 6.16.3.2.6 (Concluded)

TABLE 6.16.3.3

(1 of 8)

**K<sub>Isec</sub> SUMMARY FOR TITANIUM ALLOY Ti-6Al-4V**

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	K <sub>Q</sub> (Ksi√in)	K <sub>Isec</sub> (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)							
1300°F 2hr AC	E	R.T.	L-S	121.2	3.5% NaCl	NB	1.5	0.48	0.5	---	94.7	65*	---	1972	84282
			L-T	128.9	3.5% NaCl	NB	1.5	0.48	0.5	---	83.3	73*	---	1972	84282
1700°F 4hr FC to 1400°F AC; Diffusion Bond Thermal Cycle	P	R.T.	L-T	---	S.T.W.	DCB	5.5	1	1.5	---	---	---	---	1974	89004
						DCB	5.5	1	1.5	---	---	66*	---	1974	89004
						DCB	5.5	1	1.5	---	---	---	---	1974	89004
						DCB	5.5	1	1.5	---	---	---	---	1974	89004
			T-L	---	Field Cleaning Solvent	DCB	5.5	1	1.5	---	94	70*	---	1974	89004
						DCB	5.5	1	1.5	---	94	61*	---	1974	89004
						DCB	5.5	1	1.5	---	---	60*	---	1974	89004
						DCB	5.5	1	1.5	---	92	44*	---	1974	89004
						DCB	5.5	1	2	---	92	58*	---	1974	89004
						DCB	5.5	1	2	---	92	53*	---	1974	89004
			L-S	---	Shop Cleaning Solvent	DCB	5.5	1	1.5	---	94	69*	---	1974	89004
						DCB	5.5	1	1.5	---	---	---	---	1974	89004
1725°F 1hr WQ; 1000°F 1hr AC; (STA)	E	R.T.	L-S	145.7	3.5% NaCl	NB	1.5	0.48	0.5	---	67.2	51	---	1972	84282
				146.9	3.5% NaCl	NB	1.5	0.48	0.5	---	65.8	46	---	1972	84282
1725°F 1hr WQ; 1250°F 4hr AC; (STOA)	E	R.T.	L-S	139.4	3.5% NaCl	NB	1.5	0.48	0.5	---	77.8	60	---	1972	84282
				140.3	3.5% NaCl	NB	1.5	0.48	0.5	---	74.9	70*	---	1972	84282

TABLE 6.16.3.3 (CONTINUED)

K<sub>I<sub>acc</sub></sub> SUMMARY FOR TITANIUM ALLOY Ti-6Al-4V

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Crack (in)	K <sub>Q</sub> (Ksi√in)	K <sub>I<sub>acc</sub></sub> (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)						
1750°F 1.5hr WQ; 1050°F 1100°F 8hr; 950°F 8hr	F	R.T.	---	160.9	Aerazine 50	PTSC	0.8	0.095	---	52.2	37*	---	1969	75528
					Freon TF	PTSC	0.8	0.095	---	52.2	39*	---	1969	75528
				161.4	N <sub>2</sub> O <sub>4</sub>	PTSC	0.8	0.095	---	52.2	40*	---	1969	75528
					Aerazine 50	PTSC	0.8	0.095	---	51.5	38*	---	1969	75528
1750°F; 1000°F 2hr AC	F	R.T.	L-T	144.9	Freon TF	PTSC	0.8	0.095	---	51.5	42*	---	1969	75528
					N <sub>2</sub> O <sub>4</sub>	PTSC	0.8	0.095	---	51.5	41*	---	1969	75528
				---	3.5% NaCl	TDCB	5	1.25	2.3	50.9	31	---	1971	84360
					JP-4 Fuel	TDCB	5	1.25	2.3	50.9	43.3	---	1971	84360
1750°F WQ; 1000°F 8hr 1000°F; (Alpha+Beta)	F	R.T.	---	160	Dist Water +500	PTSC	1	0.03	0.5	43.5	40*	---	1968	77290
					Methanol	PTSC	1	0.06	0.5	45.9	>26*	---	1968	77290
					PPM Na <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>	PTSC	1	0.06	0.5	45.9	<26*	---	1968	77290
					Martin- Marietta Refined Grade Hydrazine	WOL	1.3	0.125	1.25	---	46.2*	---	1974	88700
1790°F 1.5hr WQ; 1160°F 8hr + 1025°F 8hr AC	S	R.T.	---	---	Propellant Grade Hydrazine	WOL	1.3	0.125	1.25	---	64.3*	---	1974	88700

TABLE 6.16.3.3 (CONTINUED)

(3 of 8)

**K<sub>I<sub>SCC</sub></sub> SUMMARY FOR TITANIUM ALLOY Ti-6Al-4V**

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Crack (in)	K <sub>I</sub> (Ksi/in)	K <sub>I<sub>SCC</sub></sub> (Ksi/in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)						
Alpha-Beta Forged	F	R.T.	T-L	144.9	3.5% NaCl	CT	2	1	2.25	---	36.5	27	---	1973 86688
					Industrial Atm	CT	2	1	2.25	---	36.5	27	---	1973 86688
					Seacoast Atm	CT	2	1	2.25	---	36.5	18	---	1973 86688
Beta Forged	F	R.T.	T-L	134.9	3.5% NaCl	CT	2	1	2.25	---	44.2	34	---	1973 86688
					Industrial Atm	CT	2	1	2.25	---	44.2	42	---	1973 86688
					Seacoast Atm	CT	2	1	2.25	---	44.2	42	---	1973 86688
Finish Rolled 1440°F	P	R.T.	T-S	114	3.5% NaCl	NB*	3	1.5	3	1.05	---	74.5	---	1972 84036
						NB*	3	1.5	3	1.11	---	79.6	---	1972 84036
						NB*	2	0.75	3	1.15	116	94.6*	---	1972 84036
						NB*	2	0.75	3	1.17	116	90.1*	---	1972 84036
						NB*	2	0.75	3	1.22	116	95*	---	1972 84036
						NB*	2	0.75	3	0.3	116	96*	---	1972 84036
						NB*	3	1.5	3	1.04	---	78.6	---	1972 84036
						NB*	3	2	3	0.92	---	61.5	---	1972 84036
						NB*	3	2	3	1	---	78	---	1972 84036
						NB*	3	1.5	3	1.16	---	87.2	---	1972 84036
						NB*	3	2	3	0.96	---	73.7	---	1972 84036

Ti-6Al-4V

**TABLE 6.16.3.3 (CONTINUED)**

**K<sub>Isec</sub> SUMMARY FOR TITANIUM ALLOY Ti-6Al-4V**

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	K <sub>Q</sub> (Ksi√in)	K <sub>Isec</sub> (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)							
GTA Weld; Postweld 1100° F 2hr (Heat Affected Zone)	P	R.T.	L-T	---	Field Cleaning Solvent	DCB	5.5	0.5	1.25	---	---	>48*	---	1974	89004
					Shop Cleaning Solvent	DCB	5.5	0.5	1.25	---	---	>64*	---	1974	89004
GTA Weld; Postweld 1100° F 2hr (Weld Zone)	P	R.T.	L-T	---	S.T.W.	DCB	5.5	0.5	1.25	---	---	93*	---	1974	89004
GTA Weld; Postweld 1100° F 2hr (Heat Affected Zone)	P	R.T.	L-T	---	S.T.W.	DCB	5.5	0.75	1.25	---	---	76*	---	1974	89004
						DCB	5.5	0.5	1.25	---	---	>89*	---	1974	89004
						DCB	5.5	1	1.25	---	---	58*	---	1974	89004
GTA Weld; Postweld 1200° F 1hr (Heat Affected Zone)	P	R.T.	L-T	---	S.T.W.	DCB	5.5	0.125	1.25	---	---	>67*	---	1974	89004
						DCB	5.5	0.25	1.25	---	---	>66*	---	1974	89004
GTA Weld; Postweld 1400° F 1hr (Heat Affected Zone)	P	R.T.	L-T	---	S.T.W.	DCB	5.5	0.125	1.25	---	---	>62*	---	1974	89004
						DCB	5.5	0.25	1.25	---	---	>70*	---	1974	89004
As Received; Probably Mill Annealed	P	R.T.	T-S	125	3.5% NaCl	CANT	---	---	---	---	120	105*	---	1968	74355

TABLE 6.16.3.3 (CONTINUED)

(5 of 8)

 $K_{Iacc}$  SUMMARY FOR TITANIUM ALLOY Ti-6Al-4V

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Crack (in)	$K_Q$ (Ksi√in)	$K_{Iacc}$ (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)						
Mill Annealed	S	R.T.	T-L	---	A-50	WOL	1.3	0.125	---	---	68*	---	1974	88700
					MCB	WOL	1.3	0.125	---	---	38.6*	---	1974	88700
					MCB/1% CO <sub>2</sub>	WOL	1.3	0.125	---	---	40.8*	---	1974	88700
					1 M KF	DCB	---	0.2	---	---	35*	---	1971	81221
					3 M KF	DCB	---	0.2	---	---	37*	---	1971	81221
					6 M KF	DCB	---	0.2	---	---	31*	---	1971	81221
					6M KF -1500MV	DCB	---	0.2	---	---	38*	---	1971	81221
					6M KF -1000MV	DCB	---	0.2	---	---	31*	---	1971	81221
					6M KF -500MV	DCB	---	0.2	---	---	20*	---	1971	81221
					6M KF 0 MV	DCB	---	0.2	---	---	19*	---	1971	81221
					6M KF +1000MV	DCB	---	0.2	---	---	16*	---	1971	81221
					6M KF +500MV	DCB	---	0.2	---	---	17*	---	1971	81221
					Dist. Water	DCB	---	0.2	---	---	33*	---	1971	81221
					3.5% NaCl	NB	---	---	---	61	32*	---	1969	73386
Minuteman Casing	P	R.T.	T-S	120	3.5% NaCl	CANT*	1	0.75	1	88	67*	---	1967	70931
					3.5% NaCl	CANT	0.75	0.1	---	64	55*	---	1967	70931



TABLE 6.16.3.3 (CONTINUED)

 $K_{Isc}$  SUMMARY FOR TITANIUM ALLOY Ti-6Al-4V

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	$K_q$ (Ksi $\sqrt{in}$ )	$K_{Isc}$ (Ksi $\sqrt{in}$ )	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)							
Recrystallize Anneal	P	R.T.	L-T	117	S.T.W.	DCB	5.5	1	1.5	---	74	60	60300	1976	RI006
						DCB	5.5	1	1.5	---	74	60	60300	1976	RI006
						DCB	5.5	1	1.5	---	74	55	54360	1976	RI006
						DCB	5.5	1	1.5	---	74	>69	60300	1976	RI006
				121	S.T.W.	DCB	5.5	1	1.5	---	76	63	54360	1976	RI006
						DCB	5.5	1	1.5	---	76	>67	54360	1976	RI006
						DCB	5.5	1	1.5	---	76	>69	54360	1976	RI006
						DCB	5.5	1	1.5	---	76	62	51720	1976	RI006
				122	S.T.W.	DCB	5.5	1	2.5	---	77	56	70140	1976	RI006
						DCB	5.5	1	2.5	---	77	60	54360	1976	RI006
						DCB	5.5	1	2.5	---	77	60	54360	1976	RI006
						DCB	5.5	1	2.5	---	77	59	70140	1976	RI006
			T-L	122	F.C.S.	DCB	5.5	1	1.5	---	77	70	119100	1976	RI006
					S.C.S.	DCB	5.5	1	1.5	---	77	63	112200	1976	RI006
						DCB	5.5	1	1.5	---	77	75	59100	1976	RI006
					S.T.W.	DCB	5.5	1	1.5	---	77	62	54360	1976	RI006
						DCB	5.5	1	1.5	---	77	61	60300	1976	RI006
						DCB	5.5	1	1.5	---	77	62	60300	1976	RI006
						DCB	5.5	1	1.5	---	77	62	60300	1976	RI006
						DCB	5.5	1	1.5	---	77	62	60300	1976	RI006

TABLE 6.16.3.3 (CONTINUED)

(7 of 8)

 $K_{Isc}$  SUMMARY FOR TITANIUM ALLOY Ti-6Al-4V

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Crack (in)	$K_Q$ (Ksi√in)	$K_{Isc}$ (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)						
Recrystallize Anneal (cont'd)	P (cont'd)	R.T. (cont'd)	T-L (cont'd)	122 (cont'd)	S.T.W. (cont'd)	DCB	5.5	1	---	77	58	60300	1976	RI006
				126	S.T.W.	DCB	5.5	1	---	80	55	61980	1976	RI006
						DCB	5.5	1	---	80	61	61980	1976	RI006
	F	R.T.	T-L	119	S.T.W.	DCB	5.5	1	---	75	51	60360	1976	RI006
						DCB	5.5	1	---	75	55	60360	1976	RI006
			S-L	---	S.T.W.	DCB	5.5	1	---	75	56*	60180	1976	RI006
						DCB	5.5	1	---	78	>57*	64920	1976	RI006
						DCB	5.5	1	---	78	>71*	60660	1976	RI006
						DCB	5.5	1	---	75	56*	60660	1976	RI006
						DCB	5.5	1	---	79	57	61680	1976	RI006
						DCB	5.5	1	---	79	55	64920	1976	RI006
SOL Treated 1050° F 4+4 hr	F	85	---	160	N <sub>2</sub> O <sub>4</sub> 315PSIG	PTSC	1	0.052	---	45	28*	---	1969	78535
SOL Treated 1050° F 4hr; Welded 1050° F 4hr	F	85	---	161	N <sub>2</sub> O <sub>4</sub> 315PSIG	PTSC	1	0.052	---	45	30*	---	1969	78535
				133	N <sub>2</sub> O <sub>4</sub> 315PSIG	PTSC	1.5	0.062	---	47	32*	---	1969	78535
Unspecified	---	R.T.	L-T	138	N <sub>2</sub> O <sub>4</sub> 315PSIG	PTSC	1.5	0.062	---	47	31*	---	1969	78535
				116	3.5% NaCl	CANT	---	---	---	115	95*	---	1967	70887



TABLE 6.16.3.3 (CONCLUDED)

 $K_{Isec}$  SUMMARY FOR TITANIUM ALLOY Ti-6Al-4V

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	$K_Q$ (Ksi√in)	$K_{Isec}$ (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)							
Unspecified	F	R.T.	---	105	3.5% NaCl	CANT	1.1	0.75	---	---	98	80*	---	1968	84328
					Methanol	CANT	1.1	0.75	---	---	98	60*	---	1968	84328
					N-Hexane	CANT	1.1	0.75	---	---	98	80*	---	1968	84328
Unspecified	F	R.T.	S-T	106	JP-4 Fuel	BWOL	3.075	1.249	1.25	1.37	---	>66.5	133920	1977	MA005
					JP-4 Fuel	BWOL	3.073	1.251	1.25	1.36	---	>66.6	133920	1977	MA005
					Sim. Sea Water	BWOL	3.077	1.249	1.25	1.62	---	>69.6	133920	1977	MA005
					Sim. Sea Water	BWOL	3.077	1.25	1.25	1.37	---	>69.3	133920	1977	MA005
				108	JP-4 Fuel	BWOL	3.078	1.251	1.25	1.38	---	>69	133920	1977	MA005
					JP-4 Fuel	BWOL	3.078	1.252	1.25	1.36	---	>68	133920	1977	MA005
					Sim. Sea Water	BWOL	3.077	1.251	1.25	1.36	---	>67.7	133920	1977	MA005
					Sim. Sea Water	BWOL	3.073	1.253	1.25	1.36	---	>68.5	133920	1977	MA005

\* specimen thickness does not meet minimum requirements of  $2.5 \left( \frac{K_{Isec}}{\sigma_y} \right)^2$

\* asterisk in specimen design column indicates that specimens are side-grooved

TABLE 6.17.1.1

1 of 1

**MEAN PLANE STRAIN FRACTURE TOUGHNESS  
FOR TITANIUM ALLOY Ti-6Al-4V ELI AT ROOM TEMPERATURE**

Product Form	Condition/Heat Treatment	$K_{Ic}$ (ksi $\sqrt{in}$ )									
		Specimen Orientation									
		L-T			T-L			S-L			
		Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	
Plate	RA	76.1	4.	3	76.8	0.7	3	---	---	---	
Forging	ANNEALED	83.5	1.3	3	84.3	0.4	3	---	---	---	

TABLE 6.17.1.2.1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V ELI AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED	FORGING	0.1	1-10				13.27	209.7	
		-1	8			3.1			
		-1	10				23.32		
		-0.66	8			2.97	22.01		
		-0.66	10				23.96		
		-0.33	8			2.5	21.42		
		-0.33	10				20.27		
		0.	8			1.61	21.49		
		0.	10			1.71	18.61		
		0.1	10				11.54		
		0.55	8	0.01	0.2	5.22			
RA	PLATE								

1 of 1

TABLE 6.17.1.2.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
 Ti-6Al-4V ELI AT ROOM TEMPERATURE

ENVIRONMENT: S.S.W.

ORIENTATION: L-T

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
RA	PLATE	0.1	1-10				16.66	372.39	

TABLE 6.17.1.2.3

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V ELI AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: 3.5% NaCl

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
BA	PLATE	0.	15				11.35		
		0.1	0.1					388.61	
		0.1	1					214.39	
		0.5	0.1				17.18		
		0.5	1				32.51		

### TABLE 6.17.1.2.4

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
Ti-6Al-4V ELI AT ROOM TEMPERATURE**

ORIENTATION: T-L ENVIRONMENT: ALT JP 4/H<sub>2</sub>O (D)

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)						
				$\Delta K$ Level ( $K_{SI}/in$ )						
				2.5	5.0	10.0	20.0	50.0	100.0	
BA	PLATE	0.1	1							
		0.5	1				12.9	121.9		

TABLE 6.17.1.2.5

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V ELI AT ROOM TEMPERATURE**

**ORIENTATION: T-L**                      **ENVIRONMENT: Distilled Water**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
BA	PLATE	0.	16				6.46		
		0.1	1					140.93	
		0.5	1			0.25	12.97		



TABLE 6.17.1.2.6

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V ELI AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: Dry Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
BA	PLATE	0.	16				4.47		
		0.1	1					130.8	
		0.5	0.1				11.6		
		0.5	1				11.87		
		0.8	1			1.08			



TABLE 6.17.1.2.7

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V ELI AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
ANNEALED	FORGING	0.1	1-10				12.21	249.29	
		0.1	5-20				8.34	158.75	
RA	PLATE	0.1	1-10				7.61	227.75	

### TABLE 6.17.1.2.8

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
Ti-6Al-4V ELI AT ROOM TEMPERATURE**

## ORIENTATION: T-L

## ENVIRONMENT: S.S.W.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
RA	PLATE	0.1	1-10				8.22		

TABLE 6.17.1.2.9

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V ELI AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: S.T.W.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{\text{in}}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
BA	PLATE	0.1	1					216.81	
		0.5	0.1				12.91		
		0.5	1			1.24	28.27		

TABLE 6.17.1.2.10

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-4V ELI AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: Water Sat JP4

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $K_{SI}/\sqrt{in}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
BA	PLATE	0.	16				6.09		
		0.1	0.1					117.82	
		0.1	1					104.49	
		0.5	0.1				13.05		
		0.6	1				13.53		

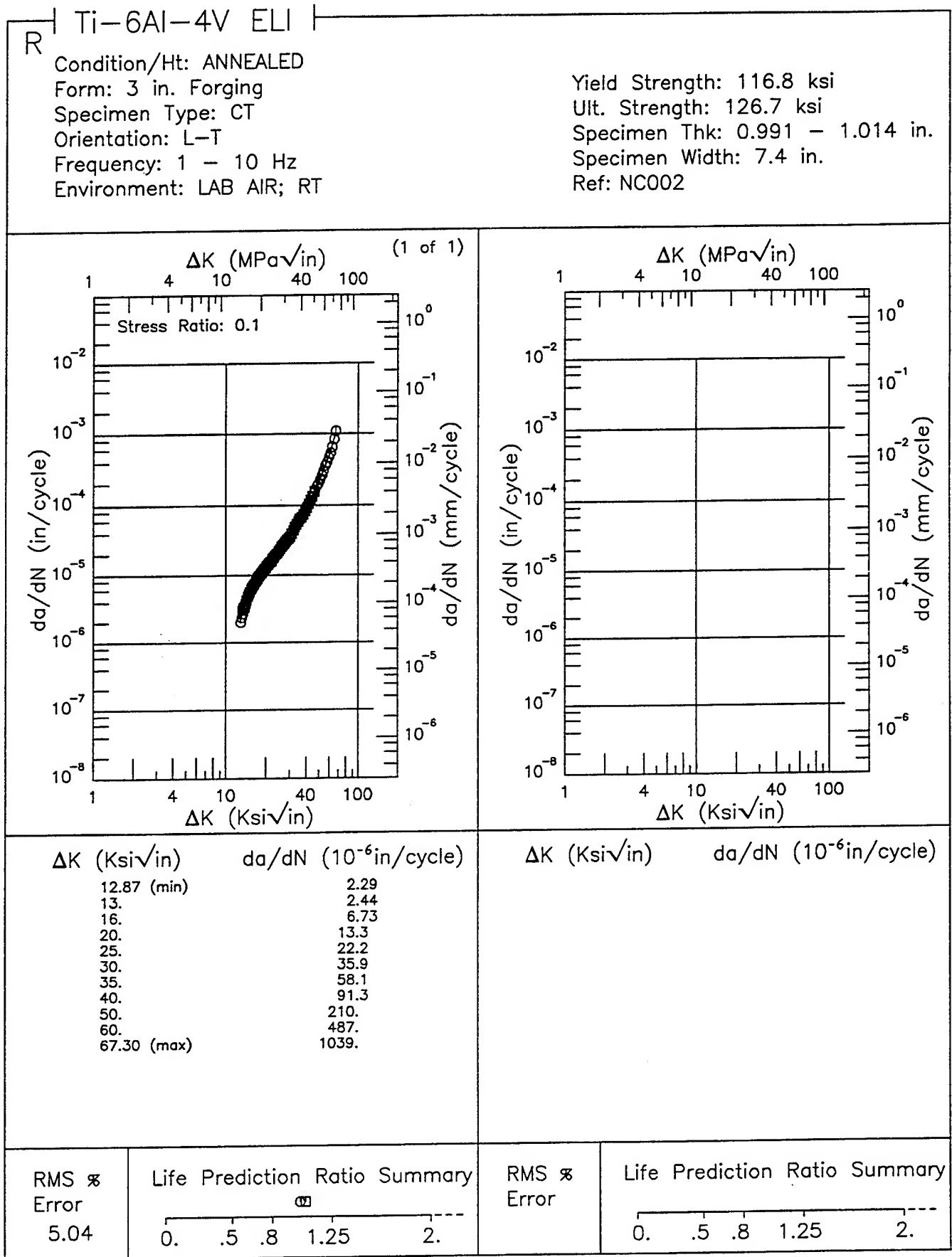
TABLE 6.17.2.1

TITANIUM Ti-6Al-4V ELI K <sub>IC</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>IC</sub> /√S) <sup>a</sup> (in.)	K <sub>IC</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>IC</sub> (Ksi√in.)	K <sub>IC</sub> MEAN	STAN DEV		
ANNEALED	Forging	3.00	R.T.	L-T	117.0	3.996	2.001	CT	2.136	1.31	84.91	83.6	1.3	1976	NC001
		3.00			117.0	3.996	2.005	CT	2.143	1.26	83.21			1976	NC001
		3.00			117.0	4.000	2.005	CT	2.130	1.24	82.42			1976	NC001
ANNEALED	Forging	3.00	R.T.	T-L	117.0	3.997	2.023	CT	2.157	1.31	84.71	84.3	0.4	1976	NC001
		3.00			117.0	3.995	2.020	CT	2.146	1.28	83.89			1976	NC001
		3.00			117.0	3.991	2.005	CT	2.126	1.29	84.23			1976	NC001
RECRYSTALLIZE ANNEAL	Plate	3.00	R.T.	L-T	119.0	4.000	2.000	CT	2.072	0.94	73.32	76.1	4.0	1976	NC001
		3.00			119.0	4.000	2.000	CT	2.088	1.14	80.66			1976	NC001
		3.00			119.0	4.000	1.999	CT	2.117	0.97	74.26			1976	NC001
RECRYSTALLIZE ANNEAL	Plate	3.00	R.T.	T-L	122.0	4.000	2.000	CT	2.059	0.97	76.19	76.8	0.7	1976	NC001
		3.00			122.0	4.000	2.000	CT	2.102	0.98	76.61			1976	NC001
		3.00			122.0	4.000	2.000	CT	2.034	1.01	77.61			1976	NC001

TABLE 6.17.2.2

TI-6AL-4V (ELI) K <sub>C</sub>																				
CONDITION HEAT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>				K <sub>C</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>o</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi√in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi√in.)	K <sub>C</sub> MEAN	STAN DEV			
BUCKLING OF CRACK EDGES RESTRAINED																				
ANNEALED	Sheet	0.03	R.T.	L-T	136.0	2.000	0.025	0.490	0.780	---	104.00	94.77*	---	---	127.27*	---	---	---	1964	60578
		0.03			136.0	2.000	0.025	0.480	0.800	---	104.00	93.65*			128.62*				1964	60578
		0.03			136.0	2.000	0.025	0.470	0.750	---	107.00	95.20*			127.37*				1964	60578
		0.03			136.0	2.000	0.025	0.480	0.750	---	104.00	93.65*			123.79*				1964	60578
		0.03			136.0	2.000	0.025	0.480	0.700	---	105.00	94.55*			119.24*				1964	60578
ANNEALED	Sheet	0.03	R.T.	L-T	136.0	4.000	0.025	1.270	1.600	---	71.80	108.22	107.2	3.0	126.55*	---	---	---	1964	60578
		0.03			136.0	4.000	0.025	1.280	1.700	---	68.50	103.76			126.31*				1964	60578
		0.03			136.0	4.000	0.025	1.260	1.650	---	70.60	105.88			127.29*				1964	60578
		0.03			136.0	4.030	0.025	1.270	1.530	---	73.60	110.82			125.44*				1964	60578
		0.03			136.0	4.040	0.025	1.270	1.650	---	74.90	112.74*			134.72*				1964	60578
ANNEALED	Sheet	0.03	R.T.	L-T	136.0	17.990	0.024	5.480	7.350	---	44.10	137.33	136.5	10.5	167.42	161.6	6.5	---	1964	60578
		0.03			136.0	17.980	0.025	5.490	7.610	---	42.10	131.26			164.08				1964	60578
		0.03			136.0	17.980	0.025	5.490	6.190	---	49.50	154.33			168.70				1964	60578
		0.03			136.0	18.000	0.025	5.500	6.980	---	41.60	129.83			152.10				1964	60578
		0.03			136.0	18.000	0.025	5.490	7.350	---	41.60	128.68			167.91				1964	60578

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.



**Figure 6.17.3.1.1**

Condition/Ht: ANNEALED  
 Form: 3 in. Forging  
 Specimen Type: CT  
 Orientation: T-L  
 Stress Ratio: 0.1  
 Environment: LAB AIR; RT

Yield Strength: 116.9 ksi  
 Ult. Strength: 127 ksi  
 Specimen Thk: 0.999 - 1.002 in.  
 Specimen Width: 7.4 in.  
 Ref: NC002

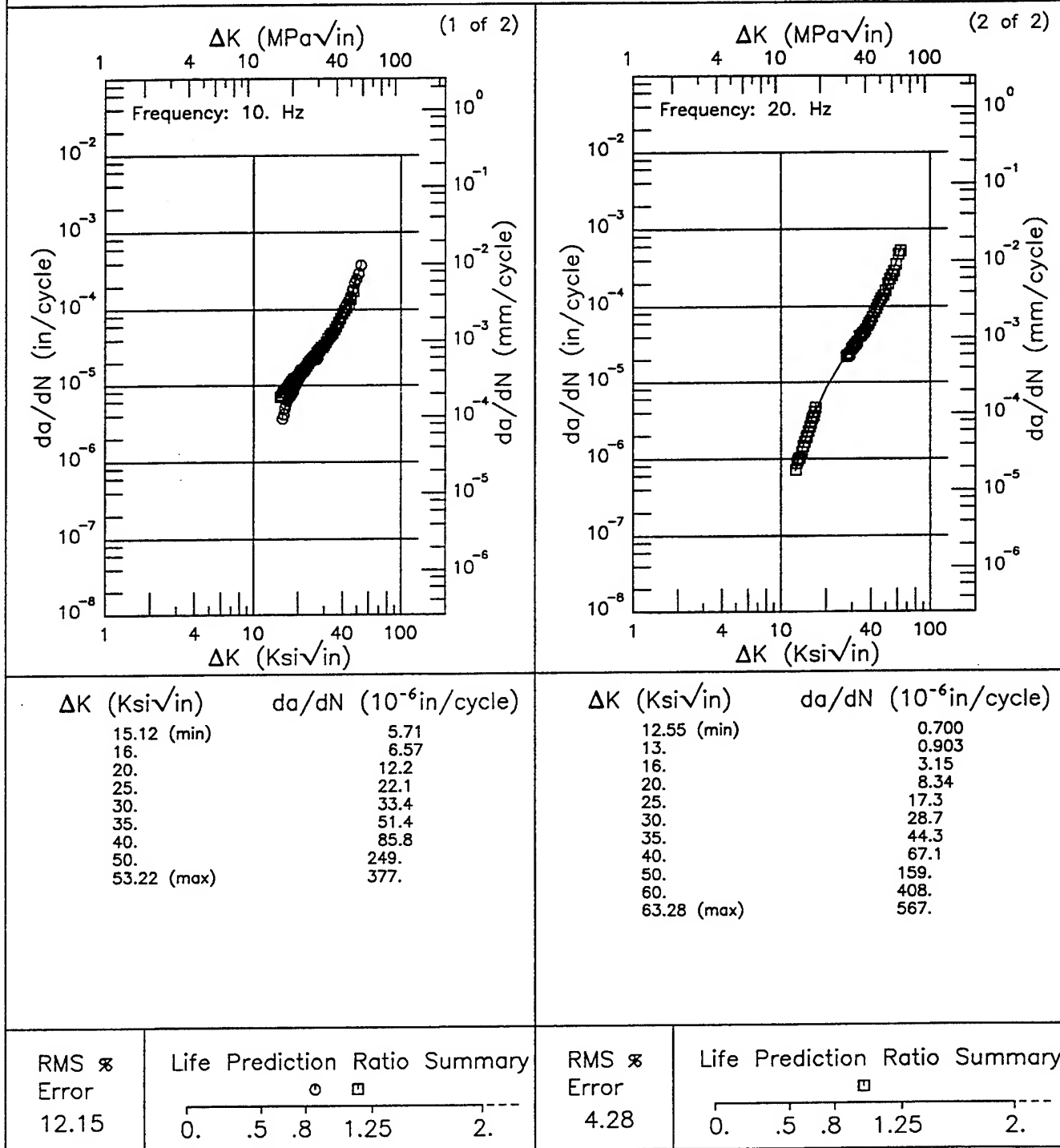


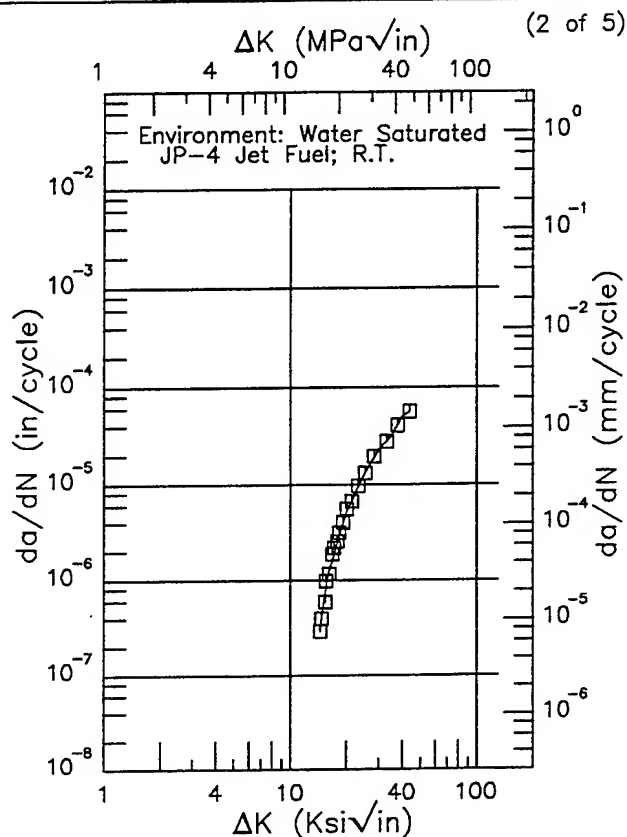
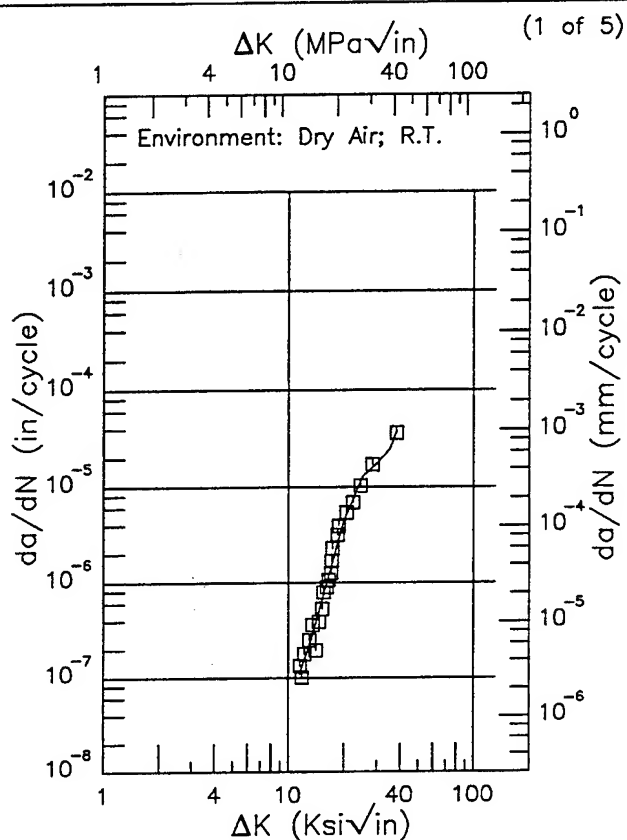
Figure 6.17.3.1.2



E | Ti-6Al-4V ELI |

Condition/Ht: BA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.  
Frequency: 15 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
11.53 (min)	0.110
13.	0.217
16.	0.934
20.	4.47
25.	12.8
30.	17.6
35.	24.9
37.95 (max)	36.1

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
14.45 (min)	0.315
16.	1.12
20.	5.09
25.	12.8
30.	22.9
35.	32.4
40.	50.1
43.49 (max)	56.2

RMS %  
Error  
21.95

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
Error  
12.01

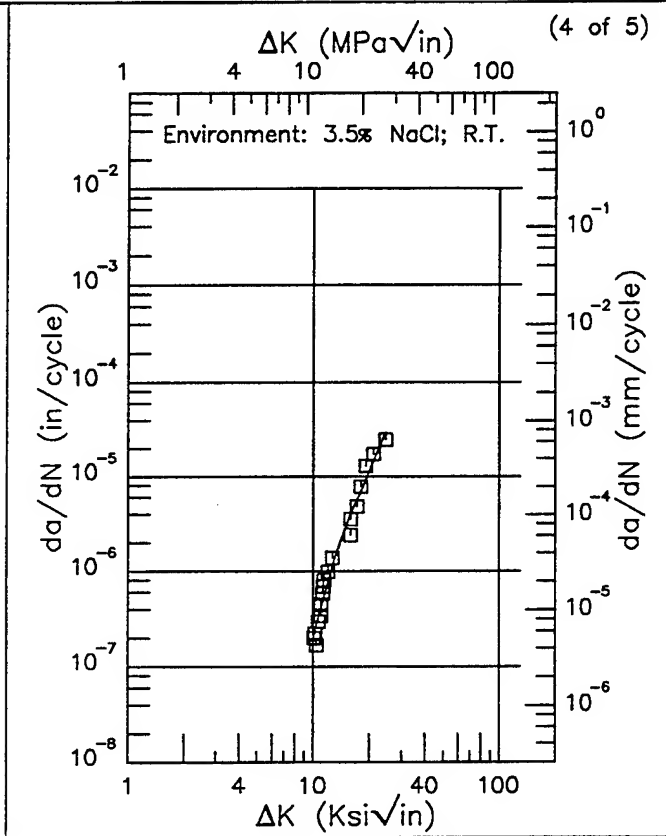
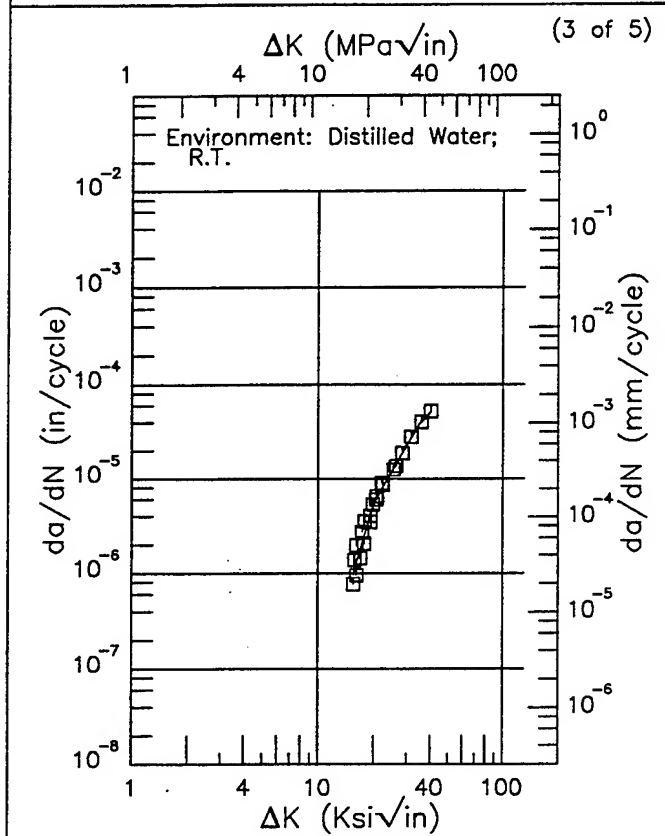
Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 6.17.3.1.3

Condition/Ht: BA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.  
Frequency: 15 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
15.47 (min)	0.959
16.	1.24
20.	5.45
25.	12.2
30.	23.0
35.	38.5
40.	51.4
40.10 (max)	51.9

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
10.07 (min)	0.227
13.	1.34
16.	4.02
20.	11.3
24.47 (max)	29.9

RMS %  
Error  
20.50

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
26.12

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.17.3.1.3 (Continued)



Condition/Ht: BA  
 Form: 1 in. Plate  
 Specimen Type: DCB  
 Orientation: T-L  
 Stress Ratio: 0.1  
 Frequency: 1 Hz

Yield Strength:  
 Ult. Strength:  
 Specimen Thk:  
 Specimen Width:  
 Ref: 88140

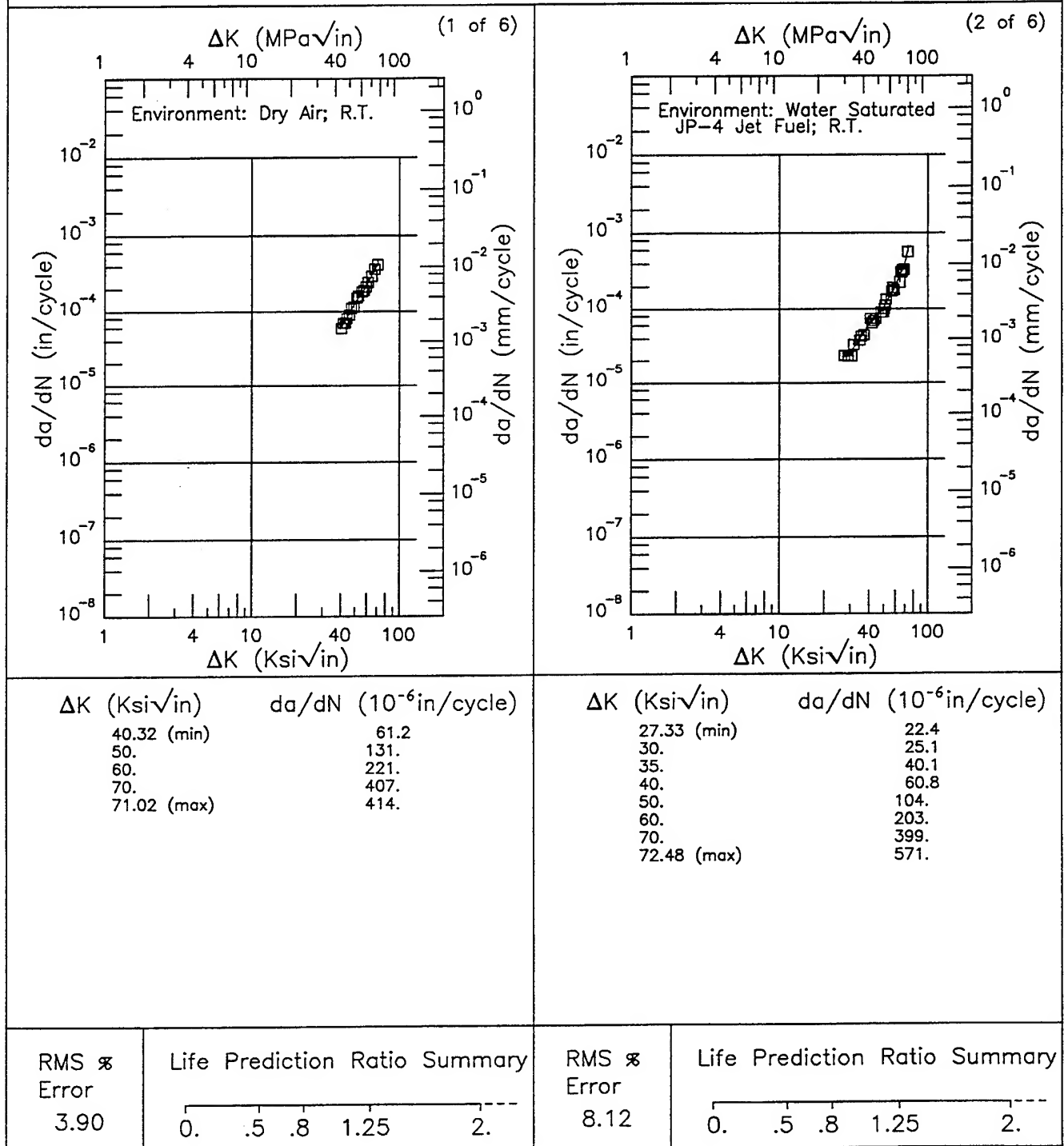
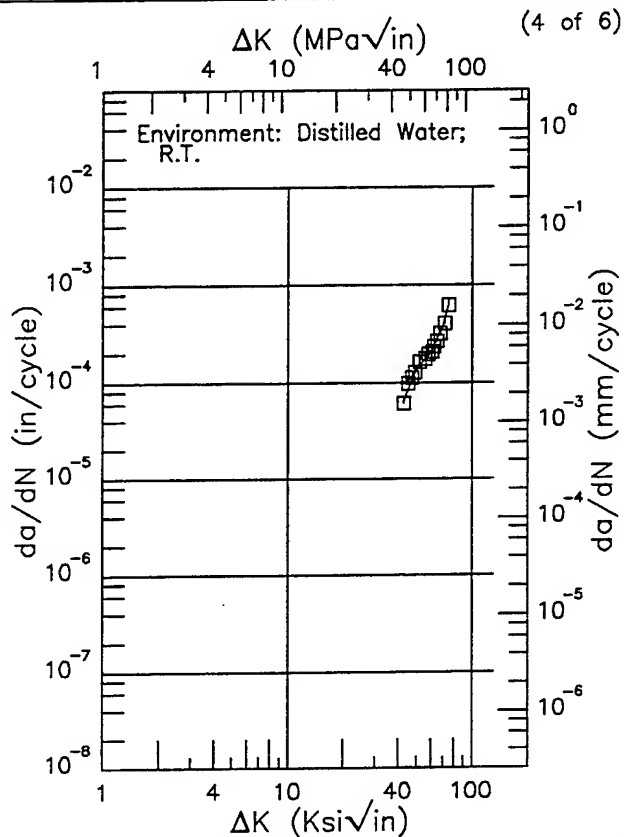
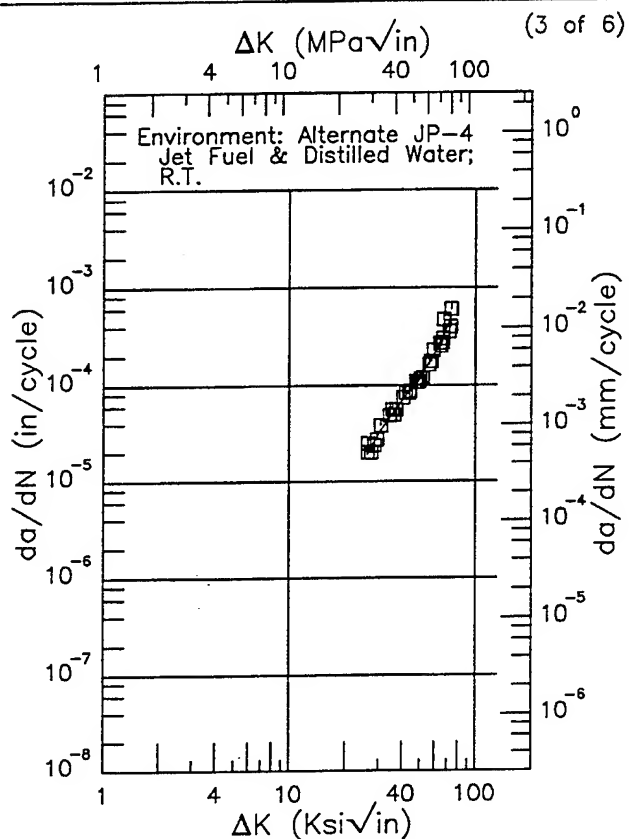


Figure 6.17.3.1.4

# Ti-6Al-4V ELI

Condition/Ht: BA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.1  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
26.24 (min)	19.2
30.	31.1
35.	48.9
40.	69.0
50.	122.
60.	212.
70.	388.
73.62 (max)	489.

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
42.57 (min)	63.1
50.	141.
60.	210.
70.	383.
74.51 (max)	607.

RMS %  
Error  
12.68

Life Prediction Ratio Summary  
0. .5 .8 1.25 2.---

RMS %  
Error  
6.05

Life Prediction Ratio Summary  
0. .5 .8 1.25 2.---

Figure 6.17.3.1.4 (Continued)

Condition/Ht: BA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.1  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140

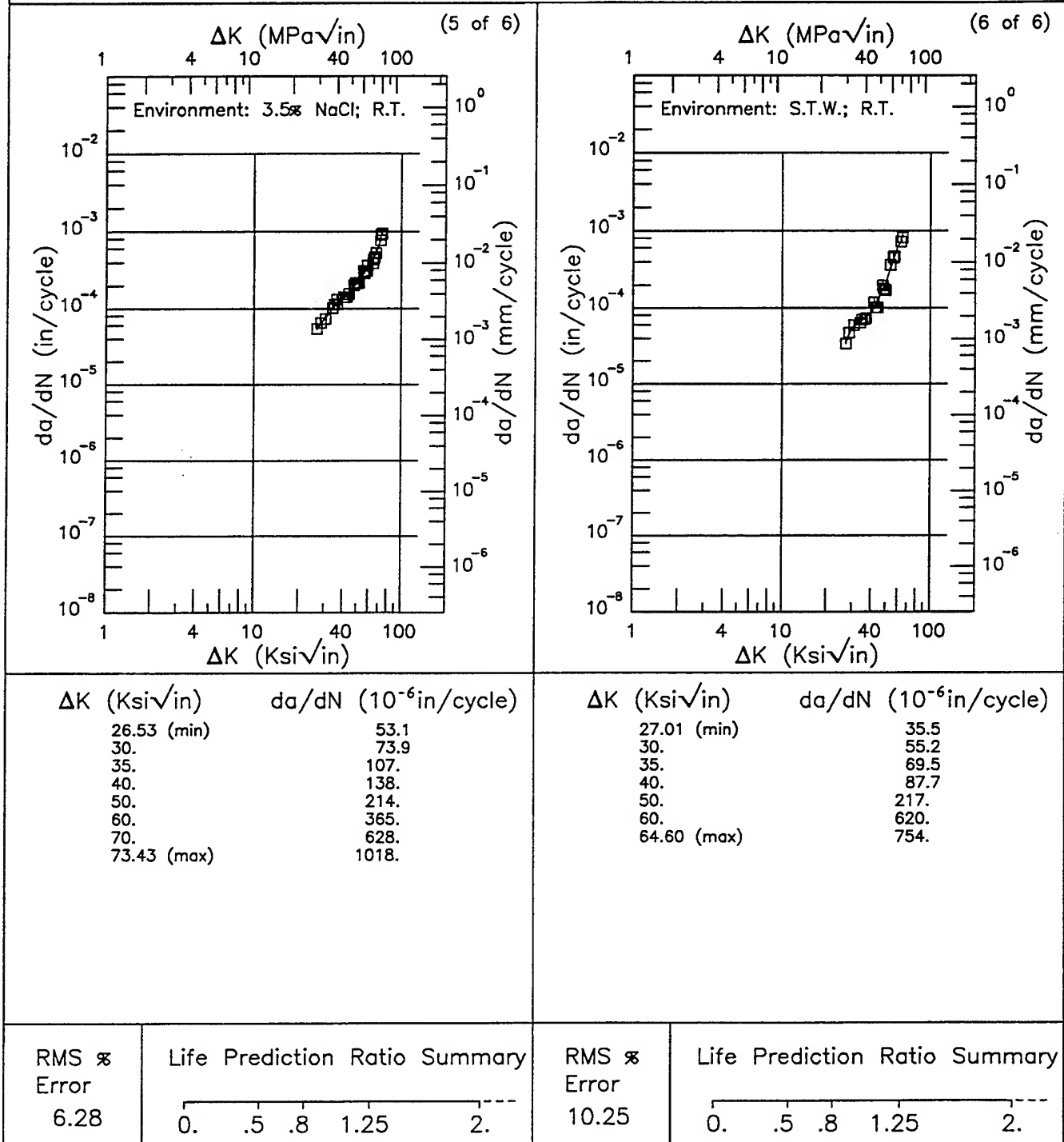
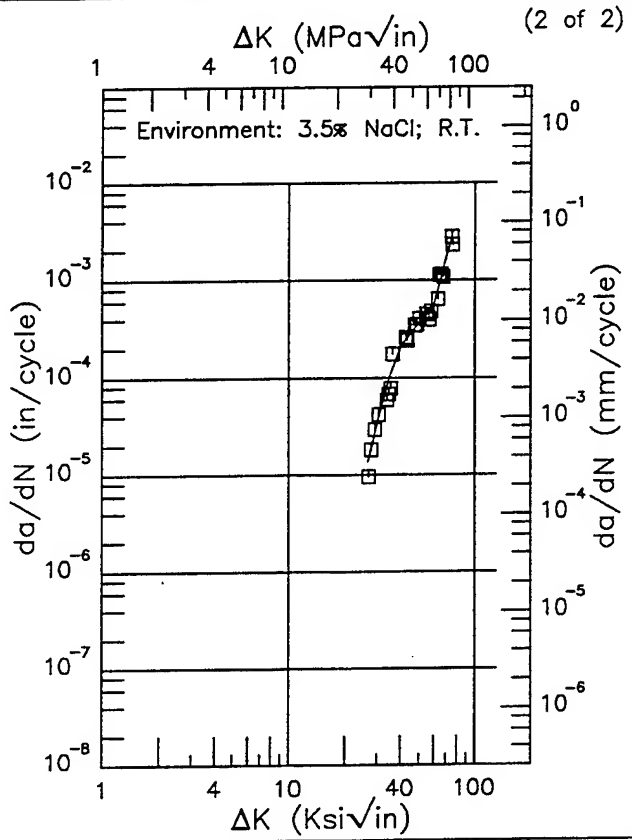
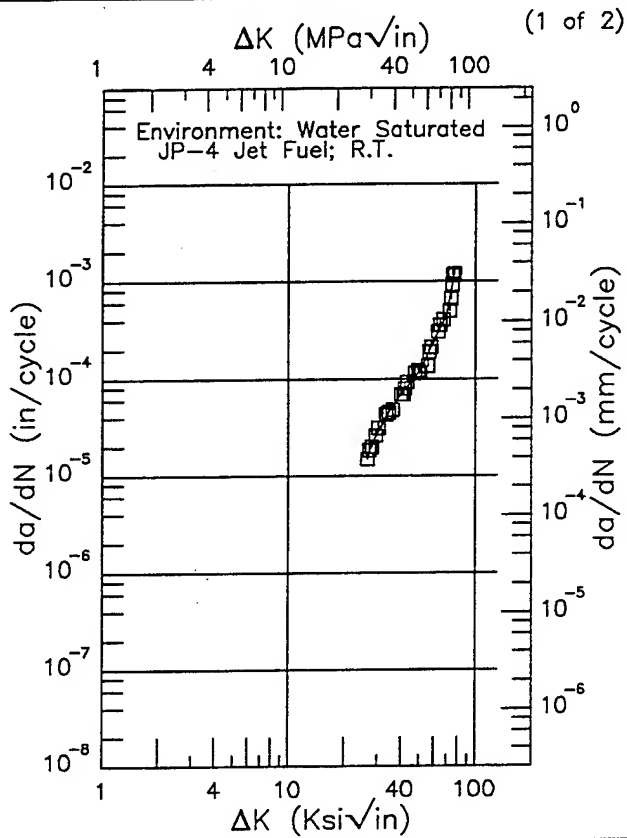


Figure 6.17.3.1.4 (Concluded)

E | Ti-6Al-4V ELI |

Condition/Ht: BA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.1  
Frequency: 0.1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
26.50 (min)	15.9
30.	27.4
35.	48.2
40.	69.5
50.	118.
60.	244.
70.	459.
76.78 (max)	1199.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
26.86 (min)	13.8
30.	33.9
35.	103.
40.	209.
50.	369.
60.	551.
70.	1627.
75.41 (max)	2758.

RMS %  
Error  
9.50

Life Prediction Ratio Summary  
0. .5 .8 1.25 2.---

RMS %  
Error  
17.62

Life Prediction Ratio Summary  
0. .5 .8 1.25 2.---

Figure 6.17.3.1.5

**This page intentionally left blank**

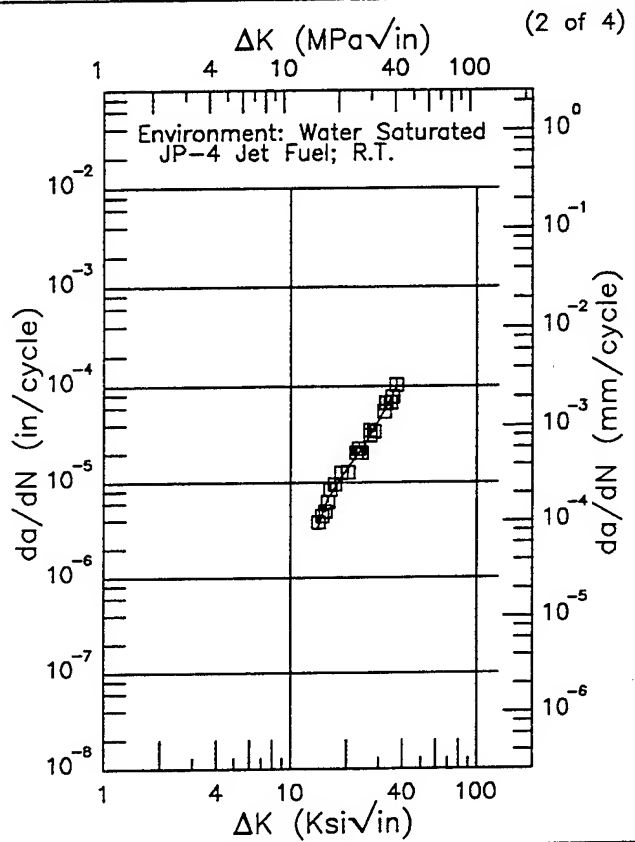
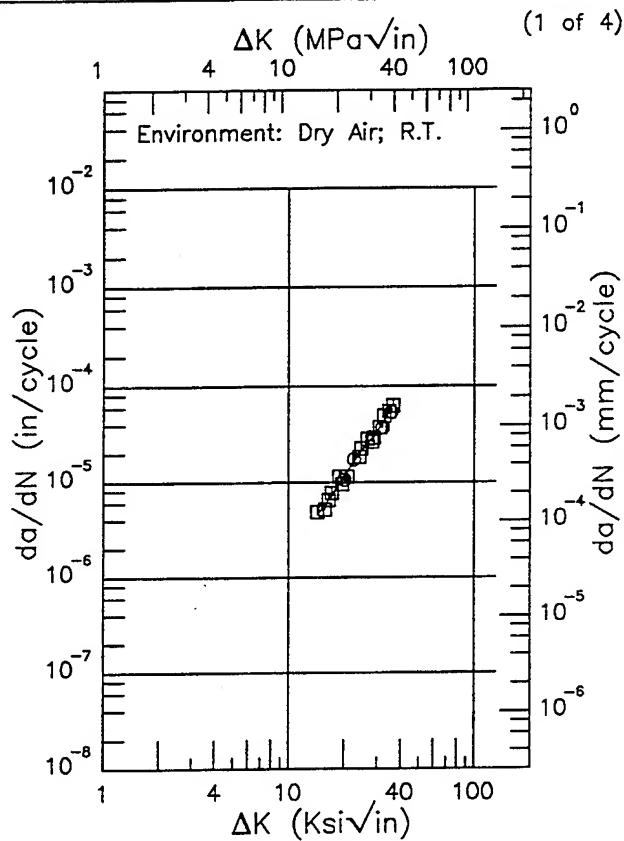


E

Ti-6Al-4V ELI

Condition/Ht: BA  
 Form: 1 in. Plate  
 Specimen Type: DCB  
 Orientation: T-L  
 Stress Ratio: 0.5  
 Frequency: 0.1 Hz

Yield Strength:  
 Ult. Strength:  
 Specimen Thk:  
 Specimen Width:  
 Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
14.31 (min)	4.58
16.	5.96
20.	11.6
25.	22.4
30.	33.4
35.	55.8
36.37 (max)	57.9

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
14.08 (min)	3.34
16.	6.89
20.	13.7
25.	24.5
30.	44.6
35.	76.9
37.10 (max)	101.

RMS %  
 Error  
 8.04

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
 Error  
 8.44

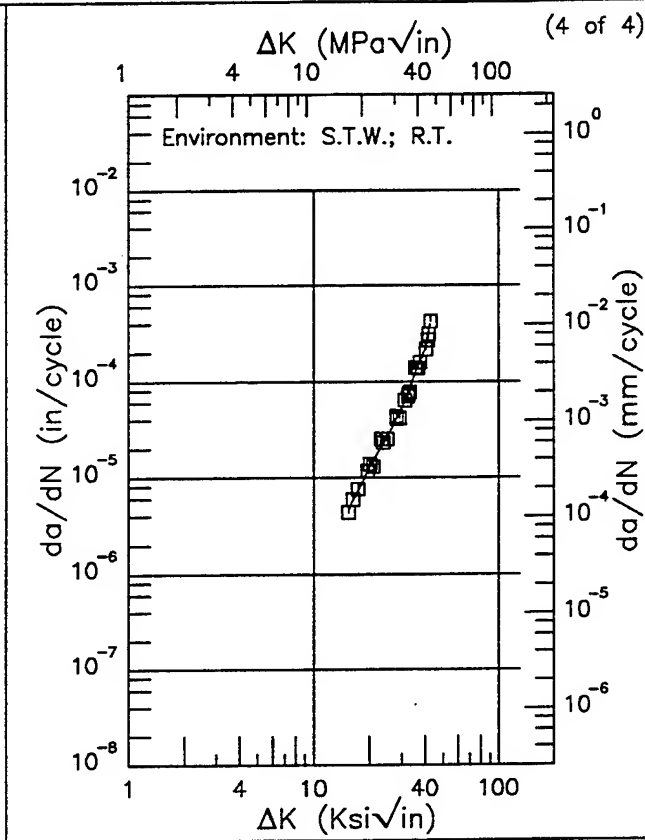
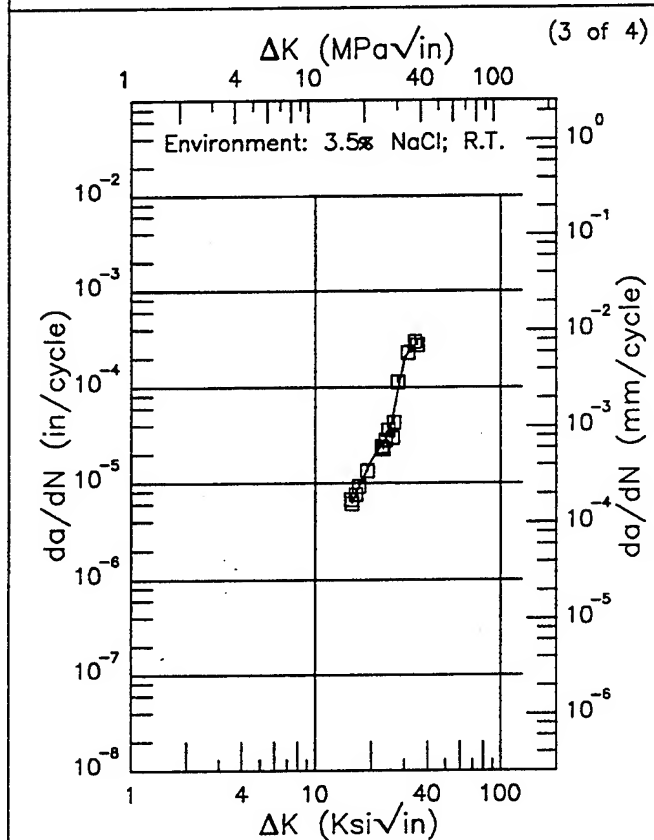
Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.17.3.1.6

Condition/Ht: BA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 0.1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
15.54 (min)	6.43
16.	6.87
20.	17.2
25.	34.1
30.	203.
35.	294.
35.28 (max)	305.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
15.38 (min)	4.60
16.	5.38
20.	12.9
25.	26.5
30.	53.2
35.	116.
40.	217.
42.70 (max)	395.

RMS %  
Error  
15.51

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
7.85

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

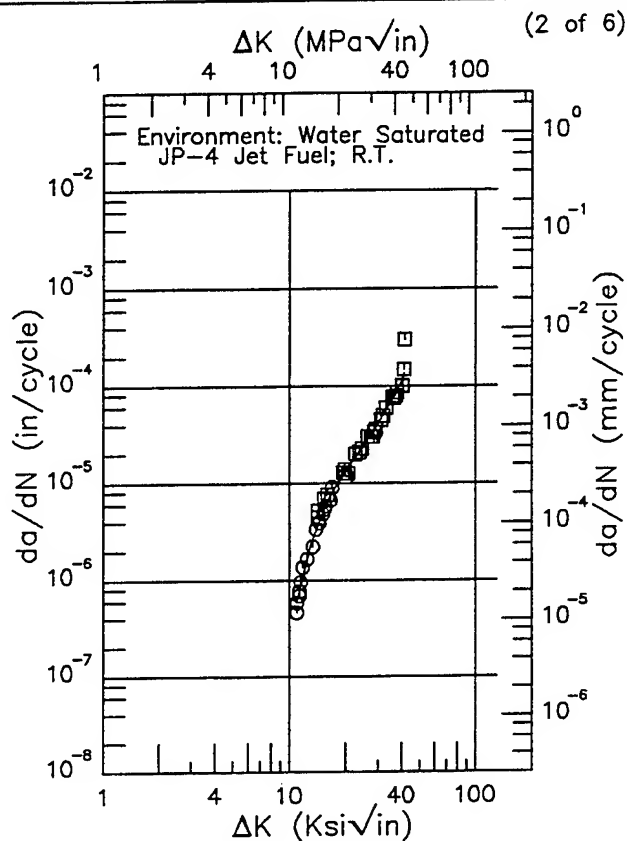
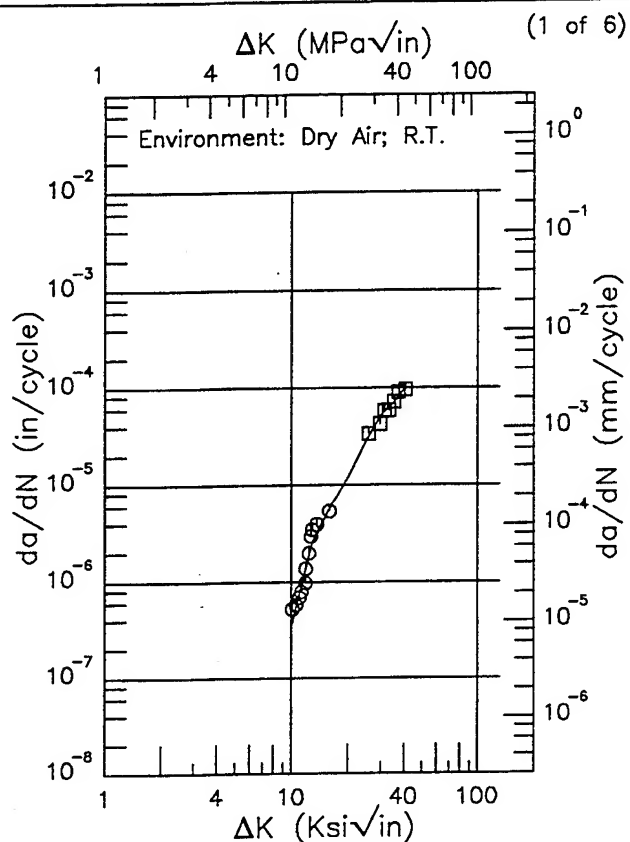
Figure 6.17.3.1.6 (Concluded)

Ti-6Al-4V ELI

E

Condition/Ht: BA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
10.10 (min)	0.370
13.	2.57
16.	5.94
20.	11.9
25.	28.3
30.	51.8
35.	68.9
40.	97.4
40.48 (max)	102.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	da/dN (10 <sup>-6</sup> in/cycle)
10.91 (min)	0.592
13.	2.27
16.	6.61
20.	13.5
25.	23.7
30.	41.8
35.	67.4
40.	113.
41.26 (max)	136.

RMS %  
Error  
20.54

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error  
22.56

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.17.3.1.7

Condition/Ht: BA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140

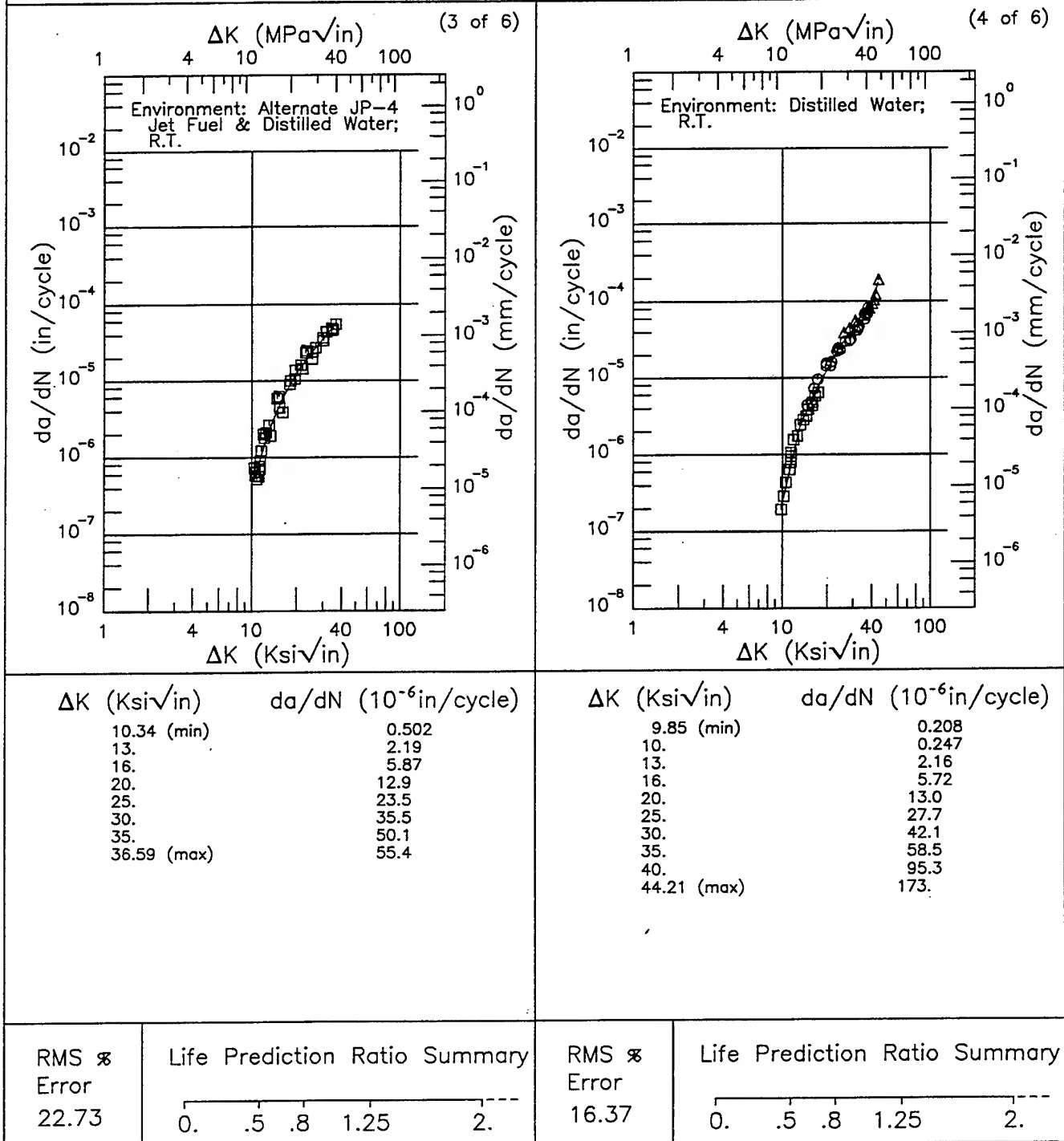
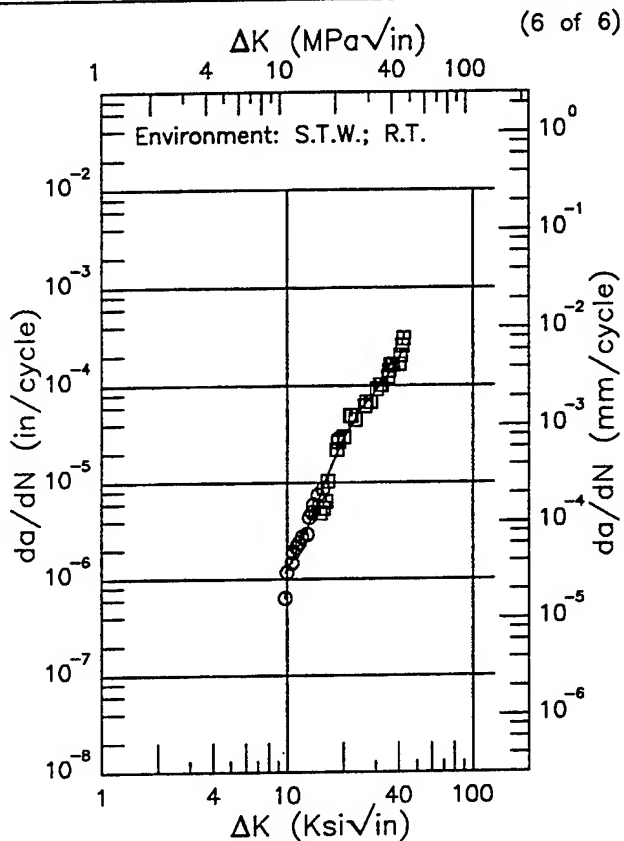
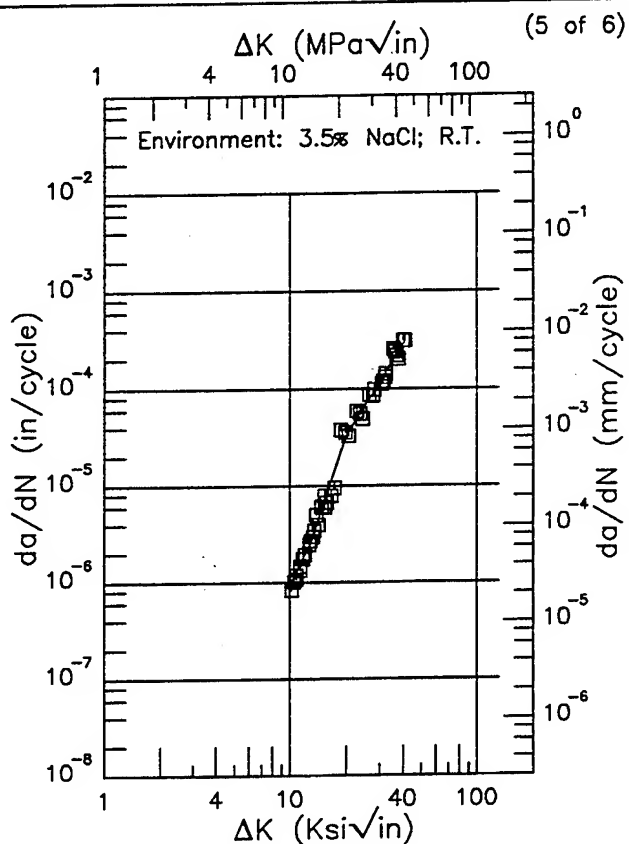


Figure 6.17.3.1.7 (Continued)

Ti-6Al-4V ELI

Condition/Ht: BA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140

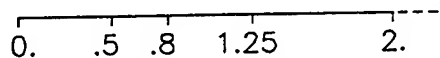


ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
10.16 (min)	0.986
13.	2.59
16.	9.25
20.	32.5
25.	67.8
30.	111.
35.	194.
40.	290.
40.69 (max)	300.

ΔK (Ksi√in)	da/dN (10 <sup>-6</sup> in/cycle)
9.76 (min)	1.16
10.	1.24
13.	3.56
16.	10.1
20.	28.3
25.	57.8
30.	88.7
35.	128.
40.	190.
42.18 (max)	232.

RMS %  
Error  
18.26

Life Prediction Ratio Summary



RMS %  
Error  
18.87

Life Prediction Ratio Summary

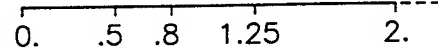


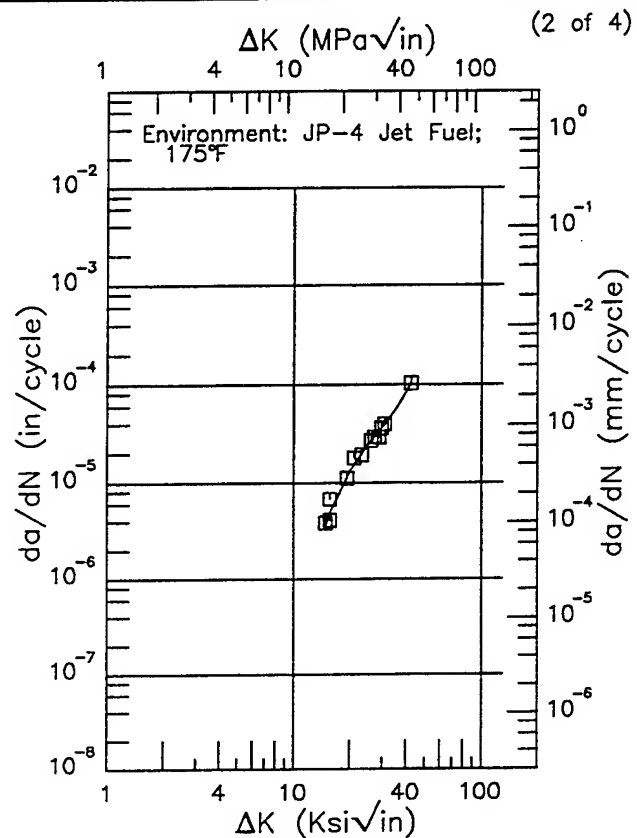
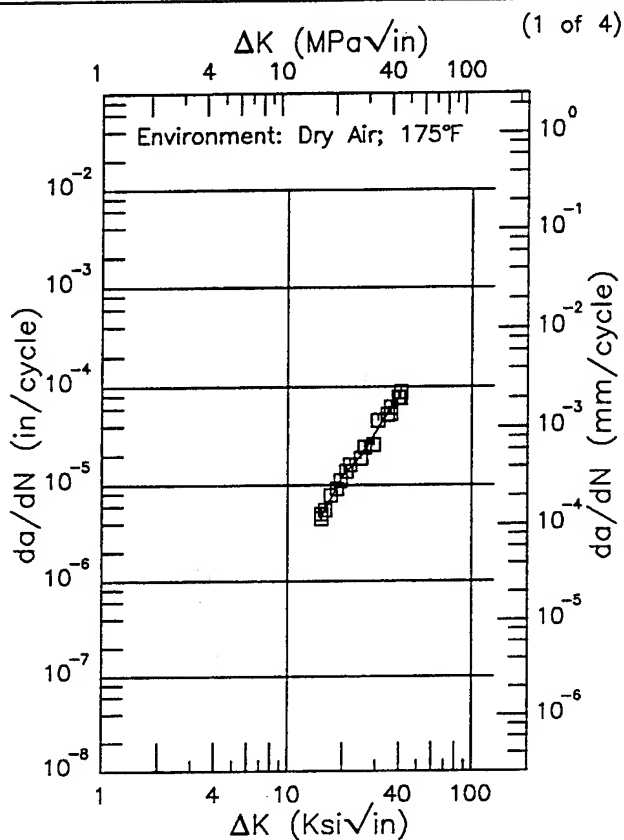
Figure 6.17.3.1.7 (Concluded)

**This page intentionally left blank**

# Ti-6Al-4V ELI

Condition/Ht: BA  
 Form: 1 in. Plate  
 Specimen Type: DCB  
 Orientation: T-L  
 Stress Ratio: 0.5  
 Frequency: 1 Hz

Yield Strength:  
 Ult. Strength:  
 Specimen Thk:  
 Specimen Width:  
 Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
15.15 (min)	4.53
16.	5.63
20.	12.4
25.	20.0
30.	34.6
35.	56.7
40.	78.4
40.96 (max)	92.9

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
14.71 (min)	3.40
16.	5.35
20.	13.1
25.	24.2
30.	37.0
35.	54.6
40.	82.7
42.28 (max)	101.

RMS %  
 Error  
 9.01

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2.

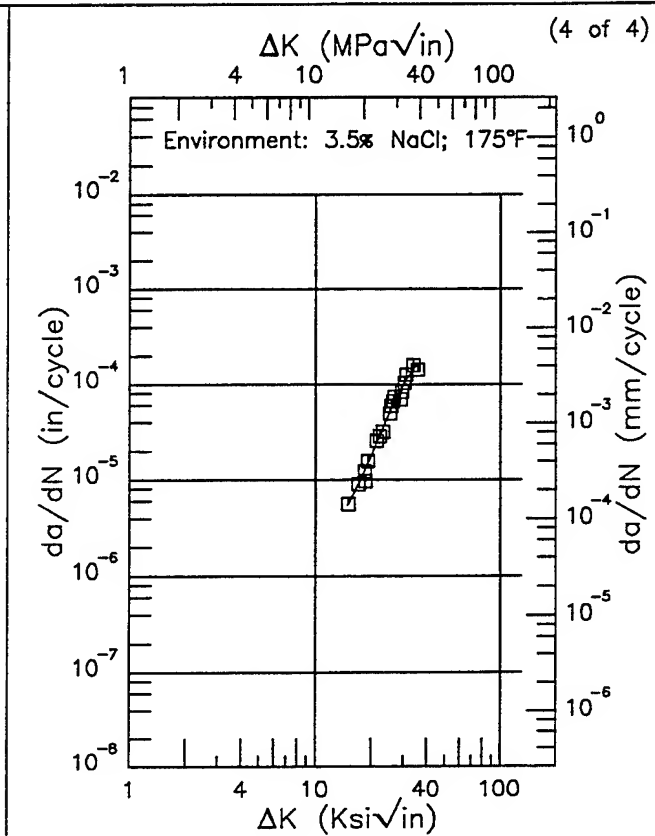
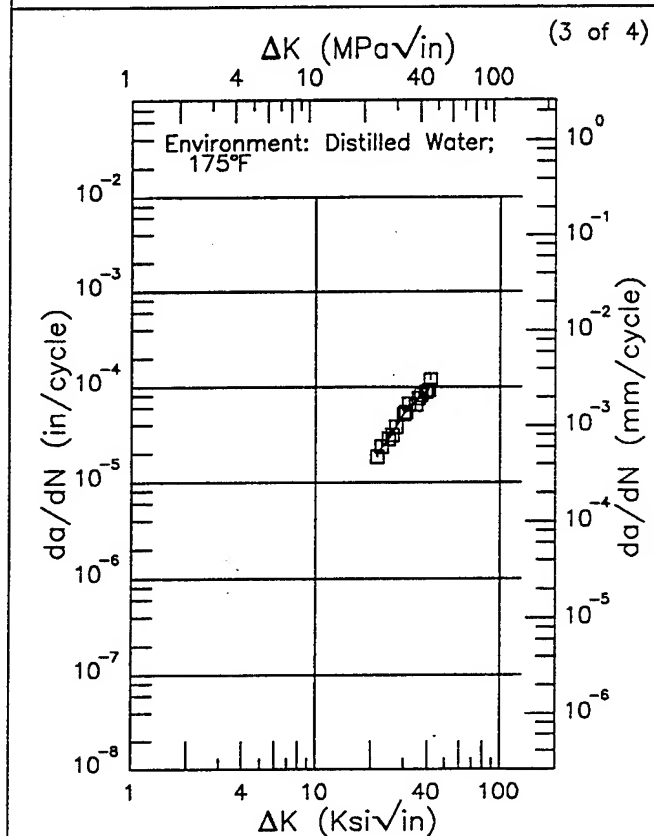
RMS %  
 Error  
 15.33

Life Prediction Ratio Summary  
 0. .5 .8 1.25 2.

Figure 6.17.3.1.8

Condition/Ht: BA  
Form: 1 in. Plate  
Specimen Type: DCB  
Orientation: T-L  
Stress Ratio: 0.5  
Frequency: 1 Hz

Yield Strength:  
Ult. Strength:  
Specimen Thk:  
Specimen Width:  
Ref: 88140



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
21.49 (min)	20.2
25.	28.9
30.	52.4
35.	71.2
40.	93.3
41.36 (max)	104.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
15.01 (min)	5.51
16.	6.93
20.	17.8
25.	48.6
30.	100.
35.	159.
35.56 (max)	165.

RMS %  
Error  
5.93

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

RMS %  
Error  
11.42

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

Figure 6.17.3.1.8 (Concluded)



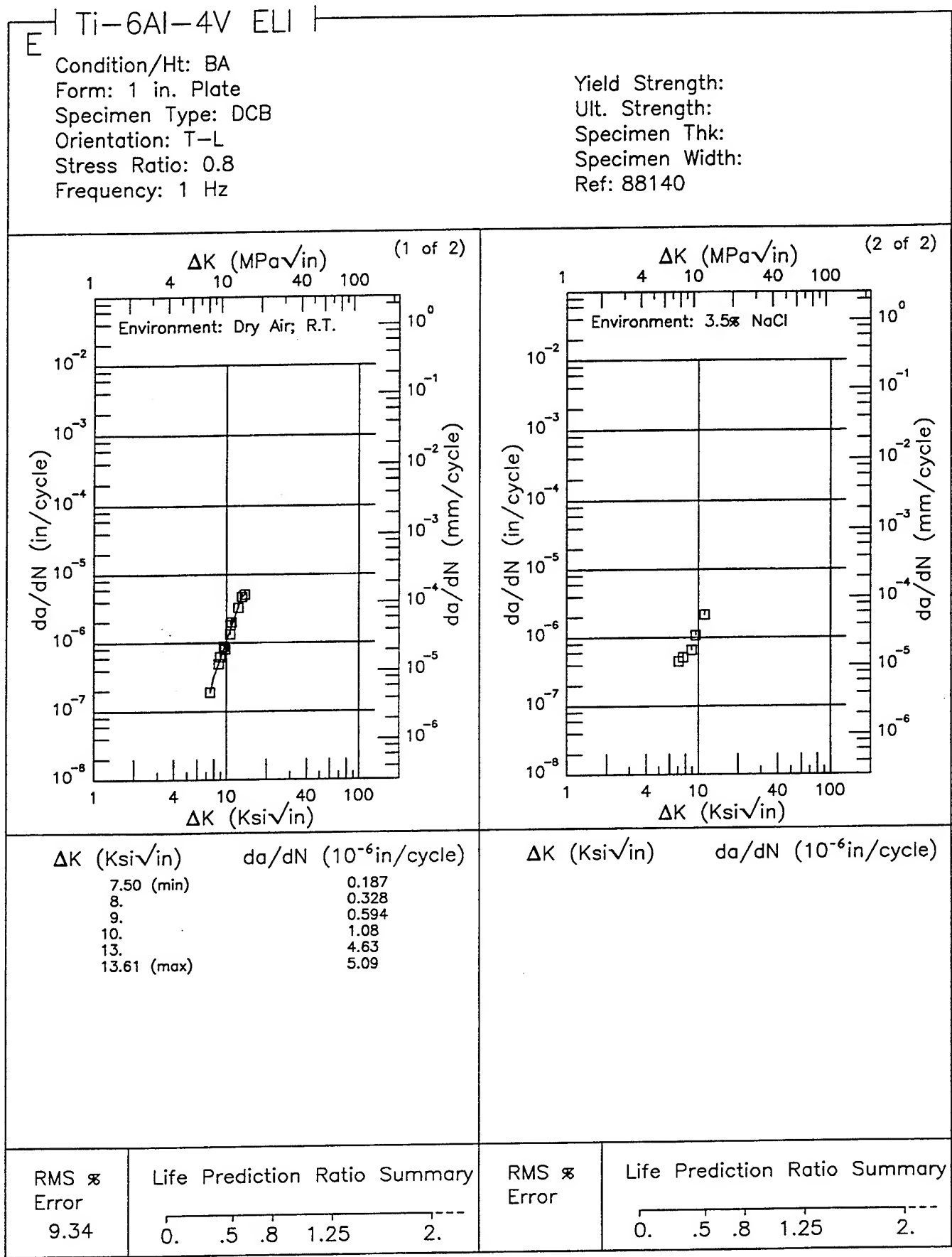


Figure 6.17.3.1.9

Condition/Ht: RA  
 Form: 3 in. Plate  
 Specimen Type: CT  
 Orientation: L-T  
 Stress Ratio: 0.1  
 Frequency: 1 - 10 Hz

Yield Strength: 119.4 ksi  
 Ult. Strength: 127.8 ksi  
 Specimen Thk: 1.003 - 1.04 in.  
 Specimen Width: 7.4 in.  
 Ref: NC002

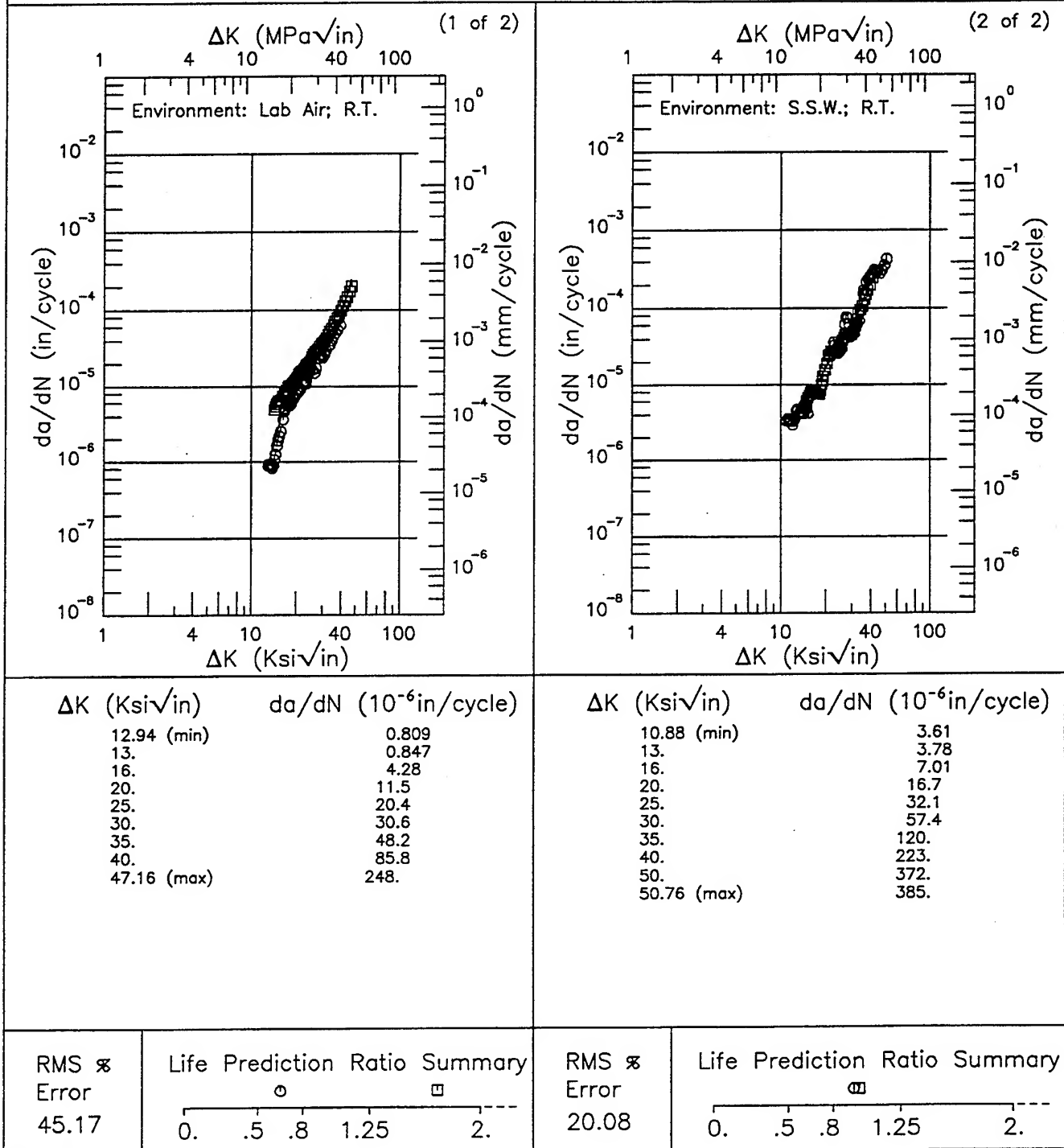
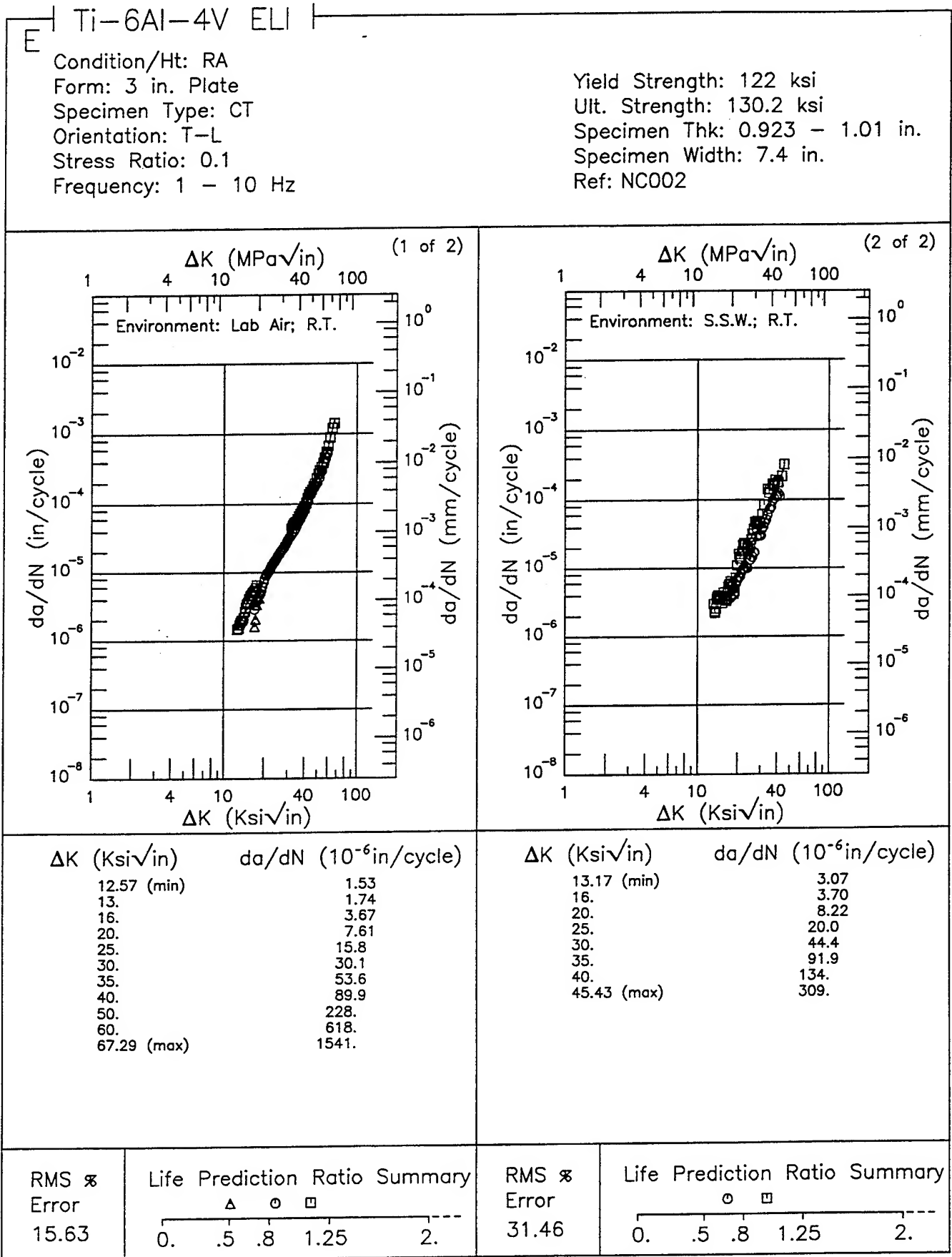


Figure 6.17.3.1.10



**Figure 6.17.3.1.11**

Condition/Ht: RA  
 Form: 0.5 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Frequency: 8 Hz  
 Environment: LAB AIR; RT

Yield Strength:  
 Ult. Strength:  
 Specimen Thk: 0.246 - 0.252 in.  
 Specimen Width: 3.995 - 4.005 in.  
 Ref: NC005

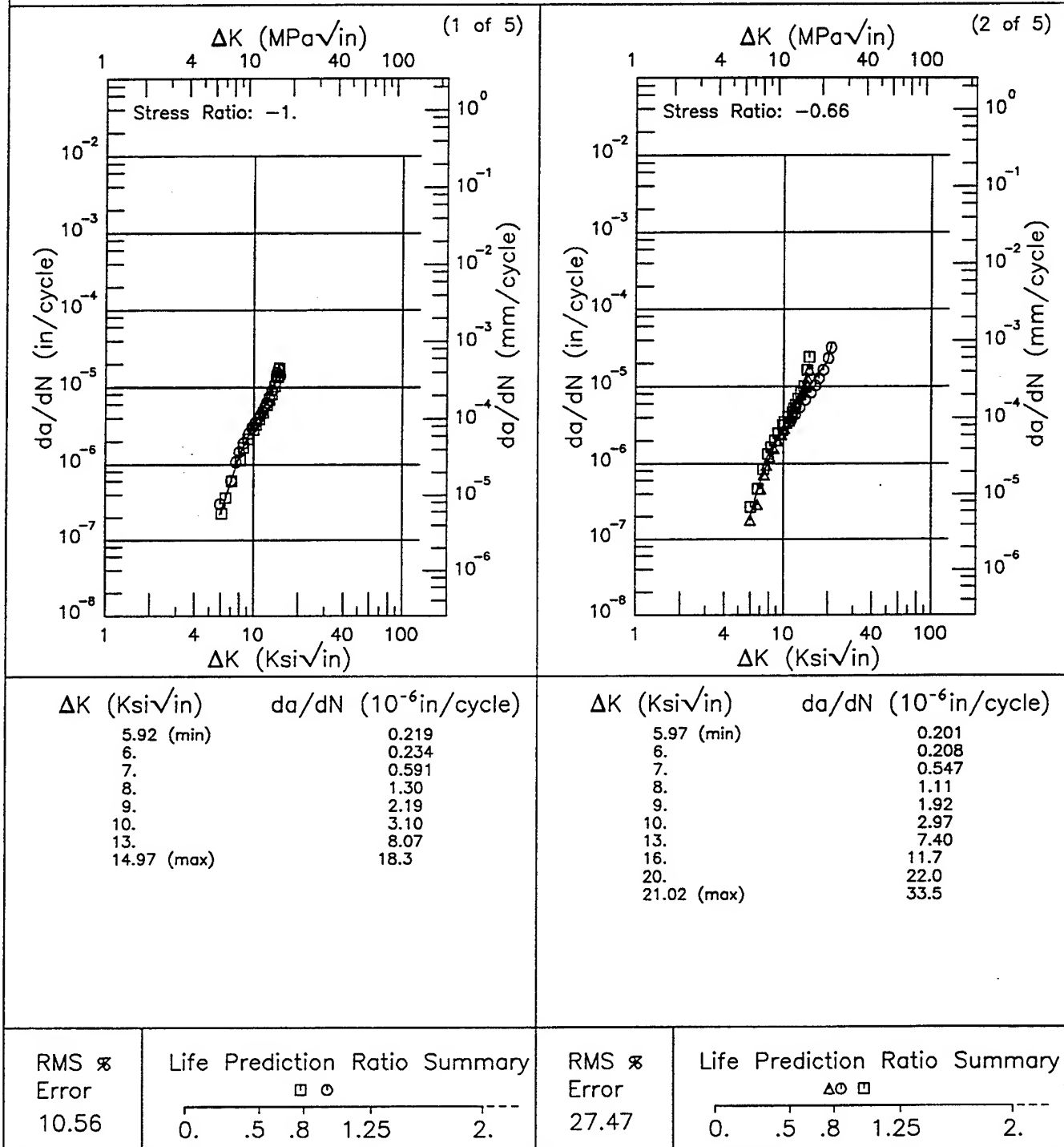


Figure 6.17.3.1.12

R

Ti-6Al-4V ELI

Condition/Ht: RA

Form: 0.5 in. Plate

Specimen Type: CCP (max load specified)

Orientation: L-T

Frequency: 8 Hz

Environment: LAB AIR; RT

Yield Strength:

Ult. Strength:

Specimen Thk: 0.246 - 0.252 in.

Specimen Width: 3.995 - 4.005 in.

Ref: NC005

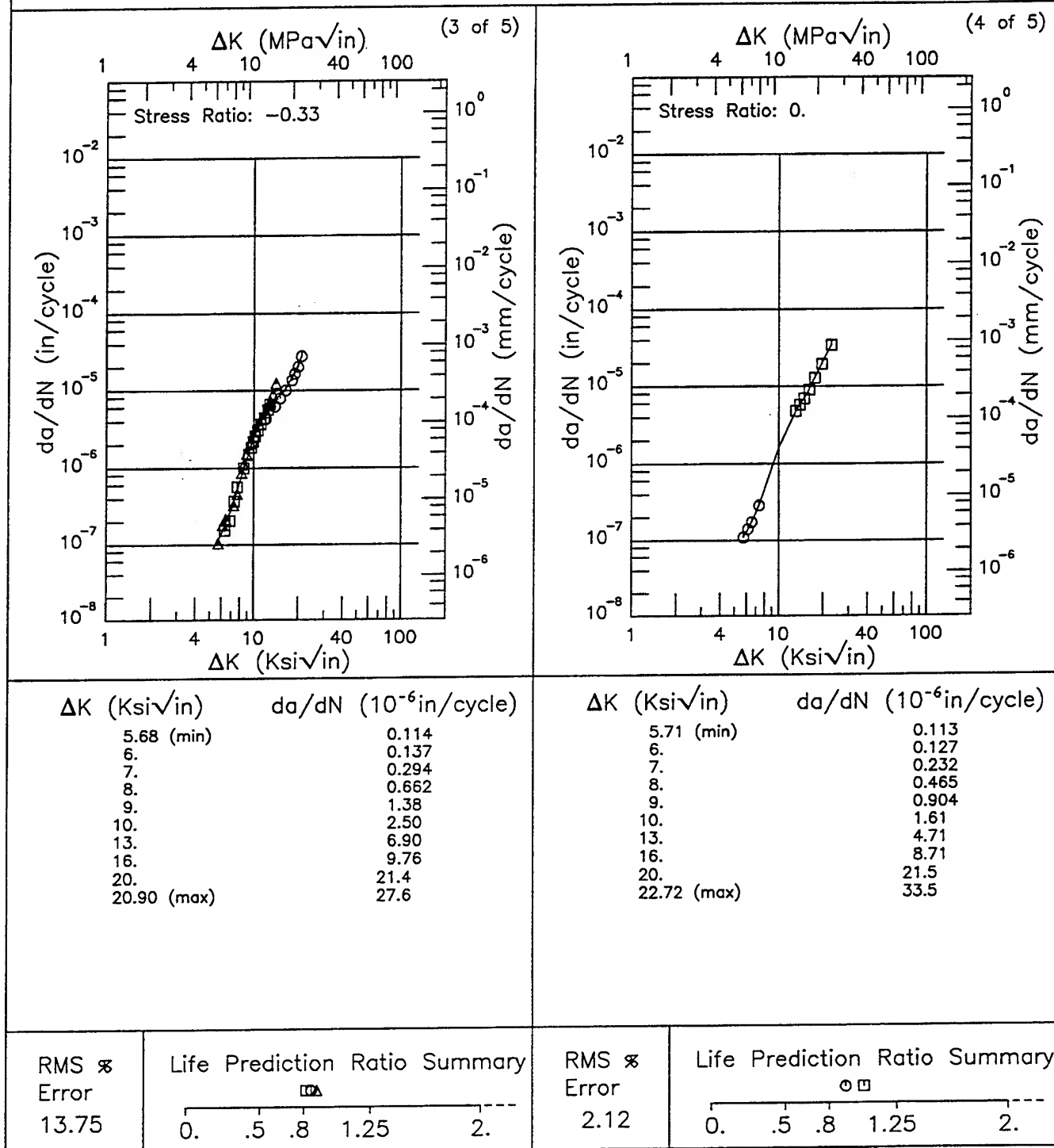


Figure 6.17.3.1.12 (Continued)

Condition/Ht: RA  
Form: 0.5 in. Plate  
Specimen Type: CCP (max load specified)  
Orientation: L-T  
Frequency: 8 Hz  
Environment: LAB AIR; RT

Yield Strength:  
Ult. Strength:  
Specimen Thk: 0.246 - 0.252 in.  
Specimen Width: 3.995 - 4.005 in.  
Ref: NC005

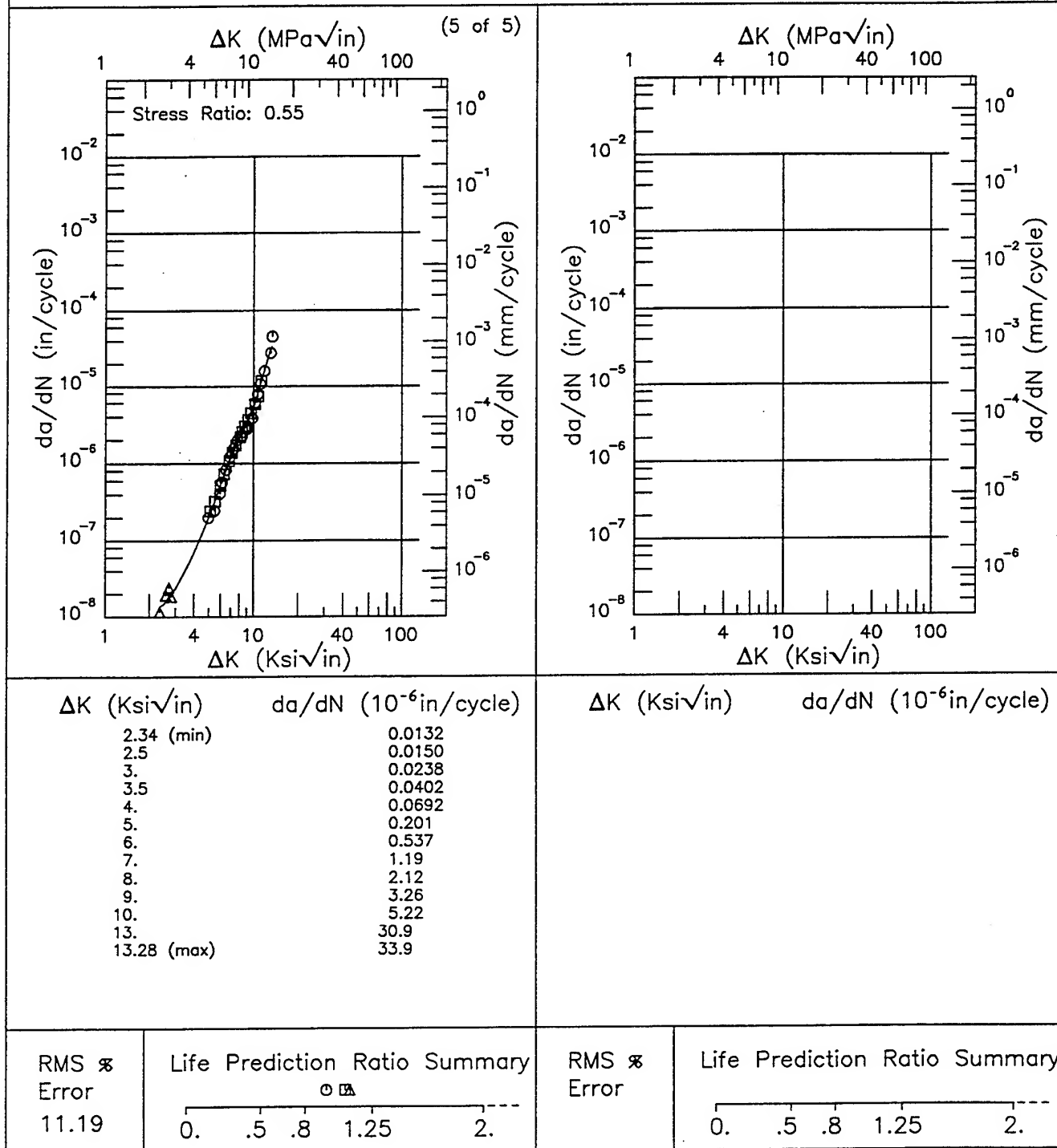


Figure 6.17.3.1.12 (Concluded)

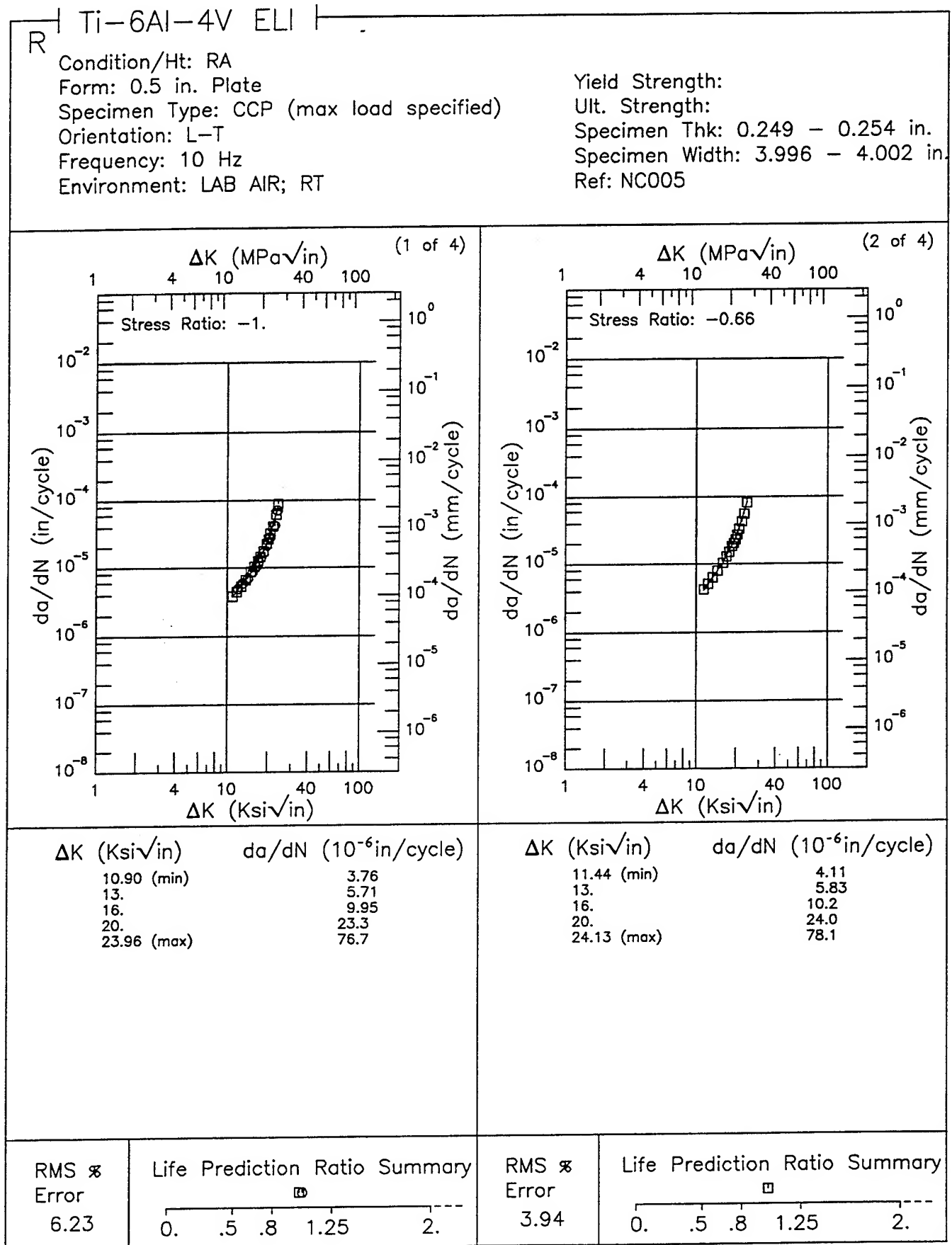


Figure 6.17.3.1.13

Condition/Ht: RA  
Form: 0.5 in. Plate  
Specimen Type: CCP (max load specified)  
Orientation: L-T  
Frequency: 10 Hz  
Environment: LAB AIR; RT

Yield Strength:  
Ult. Strength:  
Specimen Thk: 0.249 - 0.254 in.  
Specimen Width: 3.996 - 4.002 in.  
Ref: NC005

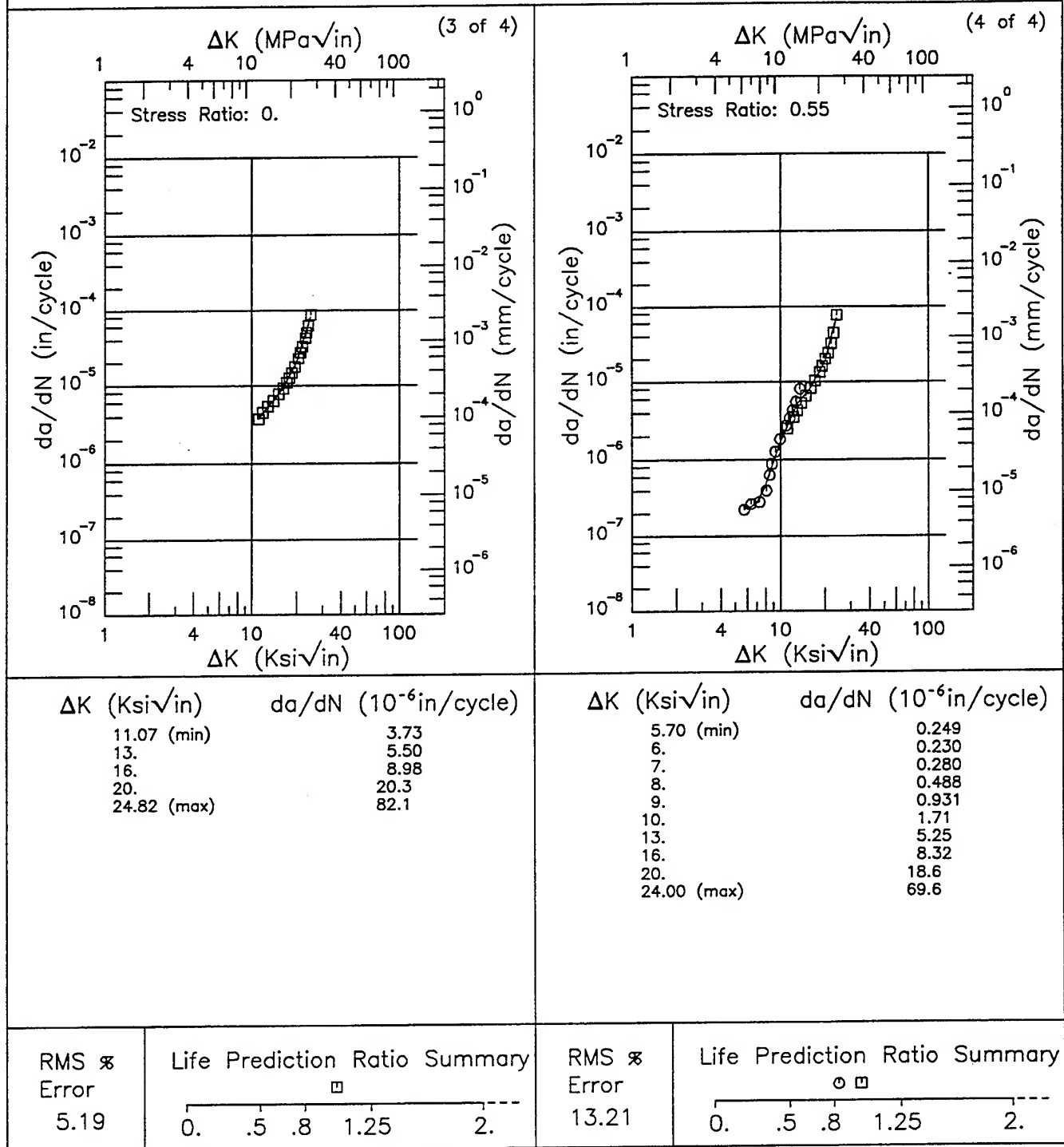


Figure 6.17.3.1.13 (Concluded)



(1 of 1)

TABLE 6.17.3.3

 $K_{Isc}$  SUMMARY FOR TITANIUM ALLOY Ti-6Al-4V (ELI)

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	$K_Q$ (Ksi√in)	$K_{Isc}$ (Ksi√in)	Test Time (min)	Test Date	Reference
						Design	Width (in)	Thick (in)							
1800°F 1hr Helium Cool	P	R.T.	T-S	115.2	3.5% NaCl	CANT*	1	0.5	1	---	112	84*	---	1967	70931

\* specimen thickness does not meet minimum requirements of  $2.5 \left( \frac{K_{Isc}^2}{\sigma_y} \right)$

\* asterisk in specimen design column indicates that specimens are side-grooved

TABLE 6.18.1.1

1 of 1

**MEAN PLANE STRAIN FRACTURE TOUGHNESS  
FOR TITANIUM ALLOY Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

Product Form	Condition/Heat Treatment	$K_{Ic}$ (ksi√in)									
		Specimen Orientation									
		L-T			T-L			S-L			
		Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	
Plate	BETA ANNEAL 1810F 1HR ARGON COOL	---	---	---	54.3	2.	3	---	---	---	
	BETA ANNEAL & STOA-1800F 0.5HR AC 1575F 0.5HR WQ 1050F 8HR AC	50.1	1.8	2	---	---	---	---	---	---	
	DUPLEX ANNEAL	---	---	---	65.1	2.	3	---	---	---	
	MA	---	---	---	35.	5.2	4	---	---	---	
	STA - 1675F 0.25HR WQ 1100F 4HR AC	---	---	---	34.1	3.8	3	---	---	---	
	STOA - 1700F 1HR WQ 1400F 1HR AC	42.9	1.2	3	46.1	3.1	4	---	---	---	
Forging	MA	58.6	2.7	3	---	---	---	---	---	---	
	STA - 1600F 0.5HR WQ 1000F 6HR AC	30.8	0.7	3	---	---	---	---	---	---	
Billet	MA	52.3	6.4	4	---	---	---	---	---	---	
	MA 1000F 2HR AC	57.1	2.2	2	---	---	---	---	---	---	
	STOA - 1700F 1HR WQ 1400F 1HR AC	62.8	6.9	4	57.	3.7	4	---	---	---	

TABLE 6.18.1.2.1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

ORIENTATION: L-S				ENVIRONMENT: 3.5% NaCl					
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
STOA	PLATE	0.1	10			2.92	31.72		

TABLE 6.18.1.2.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

ORIENTATION: L-S

ENVIRONMENT: H.H.A.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level ( $K_{SI}/\sqrt{in}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
STOA	PLATE	0.1	0.1			1.94	8.89		
		0.1	10			2.53	7.63		

TABLE 6.18.1.2.3

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: 3.5% NaCl

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
STOA	PLATE	0.1	1			2.19	33.78		
		0.1	20		0.22	3.05	19.49		

TABLE 6.18.1.2.4

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

**ORIENTATION: L-T**                      **ENVIRONMENT: Dry Argon**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)				
				$\Delta K$ Level (Ksi $\sqrt{in}$ )				
				2.5	5.0	10.0	20.0	50.0
MA	FORGING	0.02	1				10	674.14
								100.0

TABLE 6.18.1.2.5

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: H.H.A.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
STOA	PLATE	0.1	1			1.64	15.12	394.82	
		0.1	20		0.11	1.7	13.83		

TABLE 6.18.1.2.6

1 of 1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

ORIENTATION: L-T

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
MA	EXTRUSION	0.02	0.1-10			0.43	8		
		0.02	20		0.05	0.65			



TABLE 6.18.1.2.7

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

ORIENTATION: T-S

ENVIRONMENT: 3.5% NaCl

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
BA	PLATE	0.1	0.1						
STOA	PLATE	0.1	1			1.3	100.49		

TABLE 6.18.1.2.8

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

ORIENTATION: T-S

ENVIRONMENT: H.H.A.

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.6	6.0	10.0	20.0	50.0	100.0
STOA	PLATE	0.1	0.1			0.88	39.8		
		0.5	0.1			1.83	48.78		

TABLE 6.18.1.2.9

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

ORIENTATION: T-L

ENVIRONMENT: 3.5% NaCl

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)				
				$\Delta K$ Level (Ksi $\sqrt{in}$ )				
				2.5	5.0	10.0	20.0	50.0
								100.0
STOA	PLATE	0.1	0.1			2.38	28.43	

TABLE 6.18.1.2.10

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

ENVIRONMENT: H.H.A.

ORIENTATION: T-L

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi/ $\sqrt{\text{in}}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
STOA	PLATE	0.1	10			0.73	5.98	42.31	
		0.1	10			2.16	12.37		
		0.5	10		0.33	2.37	44.01		

TABLE 6.18.1.2.11

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

ORIENTATION: UNSPECIFIED				ENVIRONMENT: Lab Air					
CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (KSI/in)					
				2.5	5.0	10.0	20.0	50.0	100.0
RA (Interstitial Oxygen = 0.08%)	UNSPECIFIED							6.34	87.88

**1 of 1**

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$   
Ti-6Al-6V-2Sn AT ROOM TEMPERATURE**

## ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Kksi/in)					
				2.5	5.0	10.0	20.0	50.0	100.0
MA (Interstitial Oxygen = 0.16%)	UNSPECIFIED						12.24		

TABLE 6.18.2.1

TITANIUM Ti-6Al-6V-2Sn K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>Ic</sub> /√S) <sup>2</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksi • √in.)	K <sub>Ic</sub> MEAN	STAN DEV		
1650F 1 HR WQ 1050F 1 HR AC	Forging	4.50	-320	L-C	270.0	0.501	0.250	NB	0.122	0.02	22.60	23.6	1.3	1965	84316
		4.50			270.0	0.998	0.501	NB	0.193	0.02	24.50			1965	84316
1650F 1 HR WQ 1050F 1 HR AC	Forging	4.50	R.T.	L-C	184.0	0.501	0.250	NB	0.139	0.09	34.30	31.2	2.2	1965	84316
		4.50			184.0	0.501	0.250	NB	0.132	0.07	30.90			1965	84316
		4.50			184.0	0.998	0.501	NB	0.191	0.06	27.80			1965	84316
		4.50			184.0	0.998	0.501	NB	0.301	0.07	31.40			1965	84316
		4.50			184.0	0.501	0.251	NB	0.177	0.07	30.40			1965	84316
		4.50			184.0	0.998	0.502	NB	0.274	0.08	32.40			1965	84316
1675F 2 HR AC 1600F HR FC	Plate	2.00	R.T.	--	150.0	2.500	1.250	CT	1.250	0.34	55.00	53.8	1.8	1973	90584 (1)
		2.00			150.0	2.500	1.250	CT	1.250	0.30	52.50			1973	90584 (1)
1675F 2 HR AC 1600F HR FC	Forging	--	R.T.	--	138.0	2.500	1.250	CT	1.250	0.36	52.70	55.8	4.4	1973	90584
		--			138.0	2.500	1.250	CT	1.250	0.48	58.90			1973	90584
1675F 2 HR AC 1600F HR FC	Forged Bar	1.50	R.T.	--	150.0	2.500	1.250	CT	1.250	0.43	62.20	60.2	2.8	1973	90584
		1.50			150.0	2.500	1.250	CT	1.250	0.38	58.20			1973	90584
ANNEAL-COARSE GRAIN 1350F 2 HR AC	Forging	1.00	R.T.	--	143.0	2.000	1.000	CT	1.000	0.76	78.80	70.1	6.6	1974	88962
		1.00			143.0	2.000	1.000	CT	1.000	0.48	62.80			1974	88962
		1.00			143.0	2.000	1.000	CT	1.000	0.52	65.00			1974	88962
		1.00			143.0	2.000	1.000	CT	1.000	0.70	75.60			1974	88962
		1.00			143.0	2.000	1.000	CT	1.000	0.52	65.00			1974	88962
		1.00			143.0	2.000	1.000	CT	1.000	0.65	73.20			1974	88962

NOTES: (1) COMPOSITION(WT PERCENT) 5.6Al, 5.4V, 2.0 Sn, 0.026C, 0.57Fe, 0.014N, 0.084H, 0.180, 0.50Cu



TABLE 6.18.2.1 (CONTINUED)

TITANIUM Ti-6Al-6V-2Sn K <sub>1c</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (KSI)	SPECIMEN			CRACK LENGTH (in.) A	2.5° (K <sub>1c</sub> ) <sub>TS</sub> (in.)	K <sub>1c</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>1c</sub> (KSI) • √(in.)	K <sub>1c</sub> MEAN	STAN DEV		
ANNEAL-FINE GRAIN - 1350F 2 HR AC	Forging	6.00	R.T.	--	148.0	2.000	1.000	CT	1.000	0.34	54.60	54.0	2.1	1974	88962
		6.00			148.0	2.000	1.000	CT	1.000	0.34	54.40			1974	88962
		6.00			148.0	2.000	1.000	CT	1.000	0.36	56.60			1974	88962
		6.00			148.0	2.000	1.000	CT	1.000	0.29	50.30			1974	88962
		6.00			148.0	2.000	1.000	CT	1.000	0.34	54.40			1974	88962
		6.00			148.0	2.000	1.000	CT	1.000	0.33	53.80			1974	88962
ANNEALED 10-20% PRIMARY ALPHA ANNEALED 1350F 2 HR AC	Forging	2.50	R.T.	--	145.0	2.000	1.000	CT	1.000	0.31	51.30	50.9	0.6	1974	88962
		2.50			145.0	2.000	1.000	CT	1.000	0.30	50.40			1974	88962
ANNEALED 40-50% PRIMARY ALPHA ANNEALED 1350F 2 HR AC	Forging	2.50	R.T.	--	149.0	2.000	1.000	CT	1.000	0.28	49.40	48.8	0.9	1974	88962
		2.50			149.0	2.000	1.000	CT	1.000	0.26	48.10			1974	88962
BB AB FIN-10 BETA BLOCKED ALPHA-BETA FINISHED 10% REDUCTION, SOLUTION TREATED & OVERAGED 1650F 1 HR WQ 1300F 2 HR AC	Forging	2.50	R.T.	--	148.0	2.000	1.000	CT	1.000	0.67	76.60	72.6	5.6	1974	88962
		2.50			148.0	2.000	1.000	CT	1.000	0.54	68.70			1974	88962
BB AB FIN-10MA BETA BLOCKED ALPHA-BETA FINISHED 10% REDUCTION MILL ANNEALED 1350F 2 HR AC	Forging	2.50	R.T.	--	147.0	2.000	1.000	CT	1.000	0.60	71.80	77.0	6.8	1974	88962
		2.50			147.0	2.000	1.000	CT	1.000	0.83	84.70			1974	88962
		2.50			147.0	2.000	1.000	CT	1.000	0.64	74.60			1974	88962
BB AB FIN-30 BETA BLOCKED ALPHA-BETA FINISHED 30% REDUCTION SOLUTION	Forging	2.50	R.T.	--	148.0	2.000	1.000	CT	1.000	0.47	64.30	61.6	2.4	1974	88962
		2.50			148.0	2.000	1.000	CT	1.000	0.42	60.80			1974	88962
		2.50			148.0	2.000	1.000	CT	1.000	0.40	59.60			1974	88962



TABLE 6.18.2.1 (CONTINUED)

TITANIUM Ti-6Al-6V-2Sn K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>Ic</sub> /YS) <sup>a</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> • (Ksi • √in.)	K <sub>Ic</sub> MEAN	STAN DEV		
BB AB FIN-30MA BETA BLOCKED ALPHA-BETA FINISHED 30% REDUCTION MILL ANNEALED 1350F 2 HR AC	Forging	2.50	R.T.	---	145.0	2.000	1.000	CT	1.000	0.51	65.40	64.7	0.6	1974	88962
		145.0			2.000	1.000	CT	1.000	0.49	64.20	1974			88962	
		145.0			2.000	1.000	CT	1.000	0.49	64.40	1974			88962	
BB B FIN-10 BETA BLOCKED BETA FINISHED 10% REDUCTION SOLUTION TREATED & OVERAGED 1650F 1 HR WQ 1300F 2 HR AC	Forging	2.50	R.T.	---	140.0	2.000	1.000	CT	1.000	0.69	73.60	72.1	2.1	1974	88962
		2.50			140.0	2.000	1.000	CT	1.000	0.64	70.70			1974	88962
BB B FIN-10MA BETA BLOCKED BETA FINISHED 10% REDUCTION MILL ANNEALED 1350F 2 HR AC	Forging	2.50	R.T.	---	136.0	2.000	1.000	CT	1.000	0.69	71.70	70.5	1.0	1974	88962
		2.50			136.0	2.000	1.000	CT	1.000	0.66	70.20			1974	88962
		2.50			136.0	2.000	1.000	CT	1.000	0.66	69.70			1974	88962
BETA ANNEAL	Plate	1.00	R.T.	T-L	138.4	2.550	1.000	WOL-CT EQ.	--	0.73	74.60	--	--	1977	JEM01
BETA ANNEAL 1810F 1 HR ARGON COOL	Plate	0.50	R.T.	T-L	139.8	1.000	0.447	CT	0.568	0.36	53.20	54.3	2.0	1971	83222
		0.50			139.8	1.000	0.446	CT	0.558	0.36	53.00			1971	83222
		0.50			139.8	1.000	0.447	CT	0.513	0.41	56.60			1971	83222
BETA ANNEAL & STOA-1800F 0.5 HR AC 1575F 0.5 HR WQ 1050F 8 HR AC	Plate	0.62	R.T.	L-T	156.0	2.000	0.626	CT	1.000	0.24	48.80	50.1	1.8	1974	88186
		0.62			156.0	2.000	0.626	CT	1.000	0.27	51.30			1974	88186

TABLE 6.18.2.1 (CONTINUED)

TITANIUM Ti-6Al-6V-2Sn K <sub>1c</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5° (K <sub>1c</sub> /TYS) <sup>a</sup> (in.)	K <sub>1c</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>1c</sub> (Ksi • √in.)	K <sub>1c</sub> MEAN	STAN DEV		
BF AB FOR-ANN BETA FLECTED ALPHA-BETA FORGED ANNEALED 1350F 2 HR AC	Forging	2.50	R.T.	---	138.0	2.000	1.000	CT	1.000	0.82	79.30	75.3	3.7	1974	88962
		2.50			2.000	1.000	CT	1.000	0.73	74.50	1974			88962	
		2.50			2.000	1.000	CT	1.000	0.68	72.10	1974			88962	
BF B FOR-ANN BETA FLECTED BETA FORGED ANNEALED 1350F 2 HR AC	Forging	2.50	R.T.	---	136.0	2.000	1.000	CT	1.000	0.74	73.90	74.1	0.5	1974	88962
		2.50			2.000	1.000	CT	1.000	0.75	74.70	1974			88962	
		2.50			2.000	1.000	CT	1.000	0.74	73.80	1974			88962	
BF LAB FOR-ANN BETA FLECTED LOW ALPHA-BETA FORGED (1500F) ANNEALED 1350F 2 HR AC	Forging	2.50	R.T.	---	141.0	2.000	1.000	CT	1.000	0.38	55.20	56.3	1.6	1974	88962
		2.50			2.000	1.000	CT	1.000	0.39	55.70	1974			88962	
		2.50			2.000	1.000	CT	1.000	0.42	58.10	1974			88962	
DUPLEX ANNEAL	Plate	0.50	R.T.	T-L	150.5	2.000	0.495	CT	1.066	0.50	67.40	65.1	2.0	1971	83222 (1)
		0.50			2.000	0.500	CT	0.988	0.46	64.50	1971			83222 (1)	
		0.50			2.000	0.500	CT	1.078	0.44	63.50	1971			83222 (1)	
MILL ANNEALED	Plate	2.00	R.T.	---	157.0	2.500	1.250	CT	1.250	0.18	42.30	42.3	0.0	1973	90584 (2)
		2.00			2.500	1.250	CT	1.250	0.18	42.30	1973			90584 (2)	
		1.00			2.550	1.000	WOL-CT Eq.	---	0.20	42.80	1977			JEM01	
MILL ANNEALED	Plate	0.50	R.T.	T-L	163.3	1.000	0.495	CT	0.522	0.09	32.00	35.0	5.2	1971	83222
		0.50			1.000	0.495	CT	0.517	0.10	33.20	1971			83222	
		0.50			1.000	0.494	CT	0.537	0.09	32.10	1971			83222	

NOTES: (1) 1700F 1HR ARGON COOL 1400F 1HR ARGON COOL  
 (2) COMPOSITION(WT PERCENT) 5.6Al, 5.4V, 2.0 Sn, 0.025C, 0.57Fe, 0.014N, 0.084H, 0.180, 0.50Cu

TABLE 6.18.2.1 (CONTINUED)

TITANIUM Ti-6Al-6V-2Sn K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>Ic</sub> /TS) <sup>a</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (K <sub>Ic</sub> • √(in.))	K <sub>Ic</sub> MEAN	STAN DEV		
MILL ANNEALED	Forging	3.80	-65	L-T	169.0	2.498	1.008	CT	1.299	0.19	47.20	44.2	5.7	1973	90589
		3.80			169.0	2.502	1.007	CT	1.312	0.19	47.70			1973	90589
		3.80			169.0	2.503	1.003	CT	1.297	0.12	37.60			1973	90589
MILL ANNEALED	Forging	---	R.T.	---	144.0	2.500	1.250	CT	1.250	0.37	55.60	55.7	0.1	1973	90584
		---			144.0	2.500	1.250	CT	1.250	0.37	55.70			1973	90584
		3.80			149.0	2.499	0.999	CT	1.299	0.43	61.70			1973	90589
MILL ANNEALED	Forging	3.80	R.T.	L-T	149.0	2.495	0.985	CT	1.301	0.37	57.30	58.6	2.7	1973	90589
		3.80			149.0	2.495	0.985	CT	1.301	0.37	57.30			1973	90589
		3.80			149.0	2.501	1.006	CT	1.300	0.36	56.90			1973	90589
MILL ANNEALED	Forged Bar	1.50	R.T.	---	153.0	2.500	1.250	CT	1.250	0.20	43.10	---	---	1973	90584
MILL ANNEALED	Billet	2.20	R.T.	L-T	144.0	2.500	1.251	CT	1.332	0.37	55.60	52.3	6.4	1971	84360
		2.20			144.0	2.507	1.243	CT	1.292	0.42	58.90			1971	84360
		2.20			146.0	2.500	1.245	CT	1.216	0.30	50.40			1971	84360
		2.20			146.0	2.495	1.253	CT	1.297	0.23	44.30			1971	84360
MILL ANNEALED 1000F 2 HR AC	Billet	2.20	R.T.	L-T	155.0	2.495	1.255	CT	1.295	0.32	55.50	57.1	2.2	1971	84360
		2.20			155.0	2.500	1.254	CT	1.254	0.36	59.60			1971	84360
RECRYSTALLIZE ANNEAL	Plate	1.00	R.T.	T-L	150.0	2.550	1.000	WOL-CT Eq.	---	0.45	63.70	---	---	1977	JEM01
STA-1600F .5HR WQ 1000F 6 HR AC	Forging	3.80	-65	L-T	209.0	2.499	1.005	CT	1.287	0.05	28.80	28.4	0.6	1973	90589
		3.80			209.0	2.496	1.007	CT	1.283	0.04	27.80			1973	90589
		3.80			209.0	2.494	1.010	CT	1.326	0.05	28.70			1973	90589

TABLE 6.18.2.1 (CONTINUED)

TITANIUM Ti-6Al-6V-2Sn $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>ITYS</sub> ) <sup>2</sup> (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>ITYS</sub> (Ksi • √in.)	K <sub>ITYS</sub> MEAN	STAN DEV		
STA-1600F .5 HR WQ 1000F 6 HR AC	Forging	3.80	R.T.	L-T	184.0	2.501	1.007	CT	1.278	0.07	30.60	30.8	0.7	1973	90589
		3.80			184.0	2.498	1.005	CT	1.290	0.07	31.60			1973	90589
		3.80			184.0	2.502	1.006	CT	1.296	0.07	30.20			1973	90589
STA-1600F .5 HR WQ 1000F 6 HR AC	Forging	3.80	300	L-T	165.0	2.497	1.015	CT	1.278	0.27	54.20	53.0	3.2	1973	90589
		3.80			165.0	2.501	1.001	CT	1.292	0.28	55.50			1973	90589
		3.80			165.0	2.499	1.009	CT	1.272	0.22	49.40			1973	90589
STA-1650F 0.5 HR WQ 1050F 24 HR AC	Forging	---	R.T.	L-C	188.0	0.998	0.500	CT	0.508	0.04	24.60	25.1	0.6	1972	86494 (1)
		---			188.0	0.997	0.498	CT	0.532	0.05	25.50			1972	86494 (1)
		---			188.0	0.994	0.500	CT	0.507	0.04	24.50			1972	86494 (1)
		---			188.0	1.000	0.499	CT	0.556	0.05	25.60			1972	86494 (1)
STA-1650F 0.5 HR WQ 1050F 24 HR AC	Forging	---	R.T.	C-L	188.0	1.005	0.500	CT	0.517	0.06	29.10	28.7	2.1	1972	86494 (1)
		---			188.0	1.001	0.500	CT	0.505	0.05	25.30			1972	86494 (1)
		---			188.0	1.001	0.500	CT	0.523	0.05	25.60			1972	86494 (1)
		---			173.3	2.000	0.499	CT	1.138	0.07	29.80			1971	83222
STA-1675F 0.25 HR WQ 1100F 4 HR	Plate	1.25	R.T.	T-L	173.3	2.000	0.499	CT	1.046	0.10	35.50	34.1	3.8	1971	83222
		1.25			173.3	2.000	0.499	CT	1.080	0.11	37.00			1971	83222
		1.25			143.0	1.499	0.749	CT	0.783	0.36	54.50			1973	87230 (2)
STOA-1600F 1.5 HR WQ 1250F 6 HR AC	Extrusion	3.00	R.T.	C-R	143.0	1.496	0.750	CT	0.779	0.36	54.20	53.6	1.4	1973	87230 (2)
		3.00			143.0	1.488	0.750	CT	0.808	0.33	52.00			1973	87230 (2)
		3.00			154.0	2.000	1.000	CT	1.000	0.17	40.40			1974	88962
STOA-1650F 1 HR WQ 1300F 2 HR AC	Forging	2.50	R.T.	---	154.0	2.000	1.000	CT	1.000	0.18	41.60	41.0	0.8	1974	88962
		2.50			154.0	2.000	1.000	CT	1.000	0.18	41.60			1974	88962

NOTES: (1) ISOTHERMAL FORGING FOR AIRCRAFT NOSE WHEEL

(2) ALPHA PRECIPITATE IN BETA MATRIX

STRAIGHTNESS OF CRACK FRONT MAY NOT MEET ASTM E398-72 REQUIREMENTS

TABLE 6.18.2.1 (CONCLUDED)

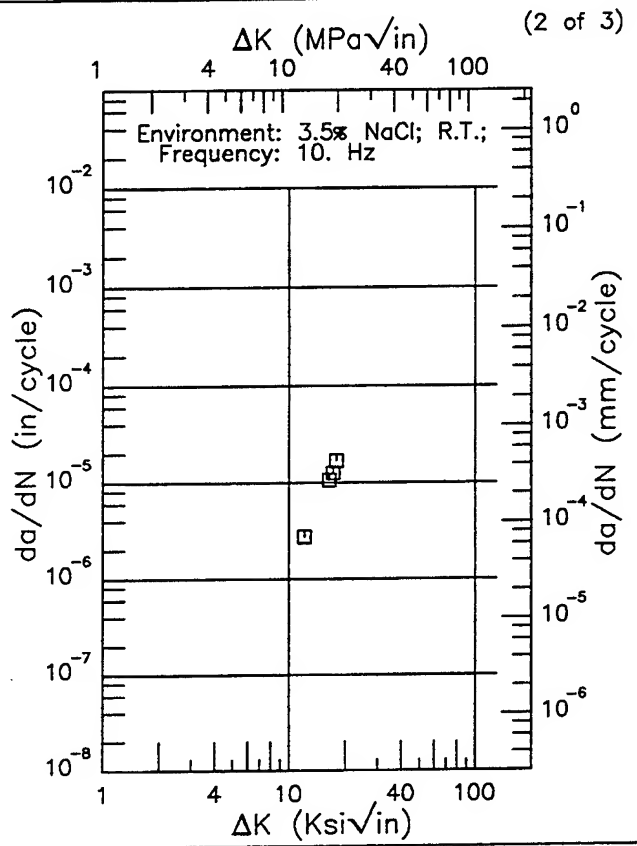
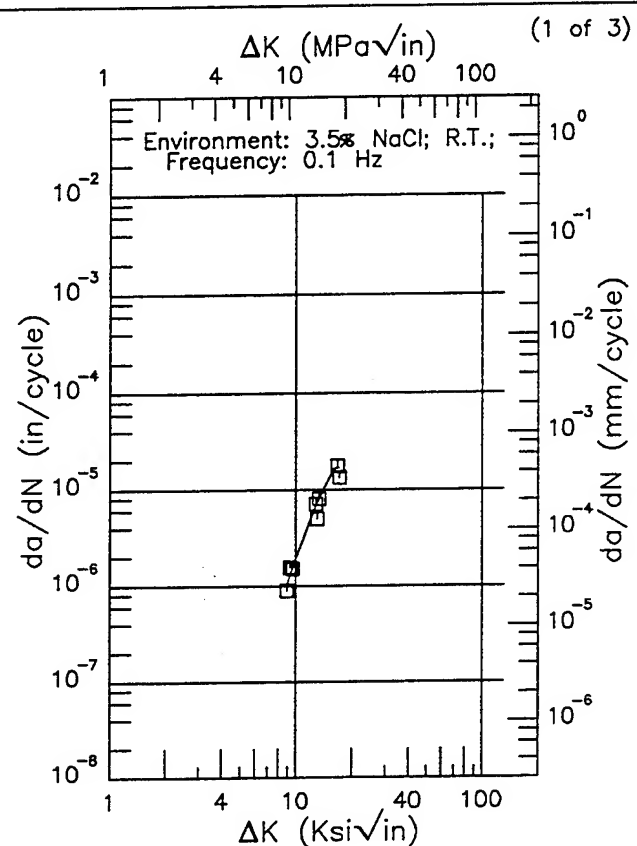
TITANIUM Ti-6Al-6V-2Sn K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5° (K <sub>Ic</sub> /√Ys) <sup>2</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (Ksi √in.)	K <sub>Ic</sub> MEAN	STAN DEV		
STOA-1700F 1 HR WQ 1400F 1 HR AC	Plate	0.38	R.T.	L-T	156.0	1.000	0.375	CT	---	0.18	41.90	42.9	1.2	1974	90981
		0.38			156.0	1.000	0.375	CT	---	0.18	42.50			1974	90981
		0.38			156.0	1.000	0.375	CT	---	0.20	44.30			1974	90981
STOA-1700F 1 HR WQ 1400F 1 HR AC	Plate	0.38	R.T.	T-L	160.0	1.000	0.375	CT	---	0.18	42.90	46.1	3.1	1974	90981
		0.38			160.0	1.000	0.375	CT	---	0.19	44.00			1974	90981
		0.38			160.0	1.000	0.375	CT	---	0.24	49.10			1974	90981
		0.38			160.0	1.000	0.375	CT	---	0.23	48.30			1974	90981
STOA-1700F 1 HR WQ 1400F 1 HR AC	Billet	12.00	R.T.	L-T	147.0	2.000	1.020	NB	---	0.33	53.60	62.8	6.9	1974	90981
		12.00			147.0	2.000	1.020	NB	---	0.57	70.40			1974	90981
		12.00			148.0	2.000	1.020	NB	---	0.46	63.70			1974	90981
		12.00			148.0	2.000	1.020	NB	---	0.46	63.40			1974	90981
STOA-1700F 1 HR WQ 1400F 1 HR AC	Billet	12.00	R.T.	T-L	144.0	2.000	1.020	NB	---	0.42	58.80	57.0	3.7	1974	90981
		12.00			144.0	2.000	1.020	NB	---	0.40	58.00			1974	90981
		12.00			145.0	2.000	1.020	NB	---	0.32	51.50			1974	90981
		12.00			145.0	2.000	1.020	NB	---	0.42	59.60			1974	90981

**This page intentionally left blank**

EF | Ti-6Al-6V-2Sn |

Condition/Ht: BA  
 Form: 0.38 in. Plate  
 Specimen Type: PTSF (max stress specified)  
 Orientation: T-S  
 Stress Ratio: 0.1

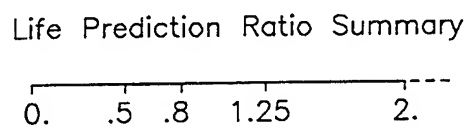
Yield Strength: 130 - 160 ksi  
 Ult. Strength: 168 ksi  
 Specimen Thk: 0.375 in.  
 Specimen Width: 5 in.  
 Ref: 90981



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.91 (min)	1.01
9.	1.07
10.	1.94
13.	7.24
16.	16.6
17.02 (max)	16.9

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS %  
 Error  
 16.37



RMS %  
 Error

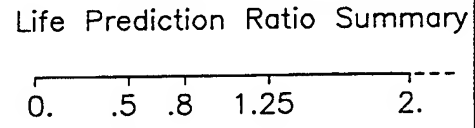
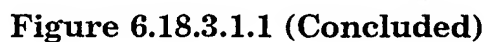


Figure 6.18.3.1.1

FF

Yield Strength: 130 — 160 ksi  
Ult. Strength: 168 ksi  
Specimen Thk: 0.375 in.  
Specimen Width: 5 in.  
Ref: 90981





F | Ti-6Al-6V-2Sn |

Condition/Ht: MA

Form: Extrusion

Specimen Type: CCP (max load specified)

Orientation: L-T

Stress Ratio: 0.02

Environment: LAB AIR; RT

Yield Strength: 143 ksi

Ult. Strength: 157 ksi

Specimen Thk: 0.081 - 0.082 in.

Specimen Width: 3.509 - 3.519 in.

Ref: MA002

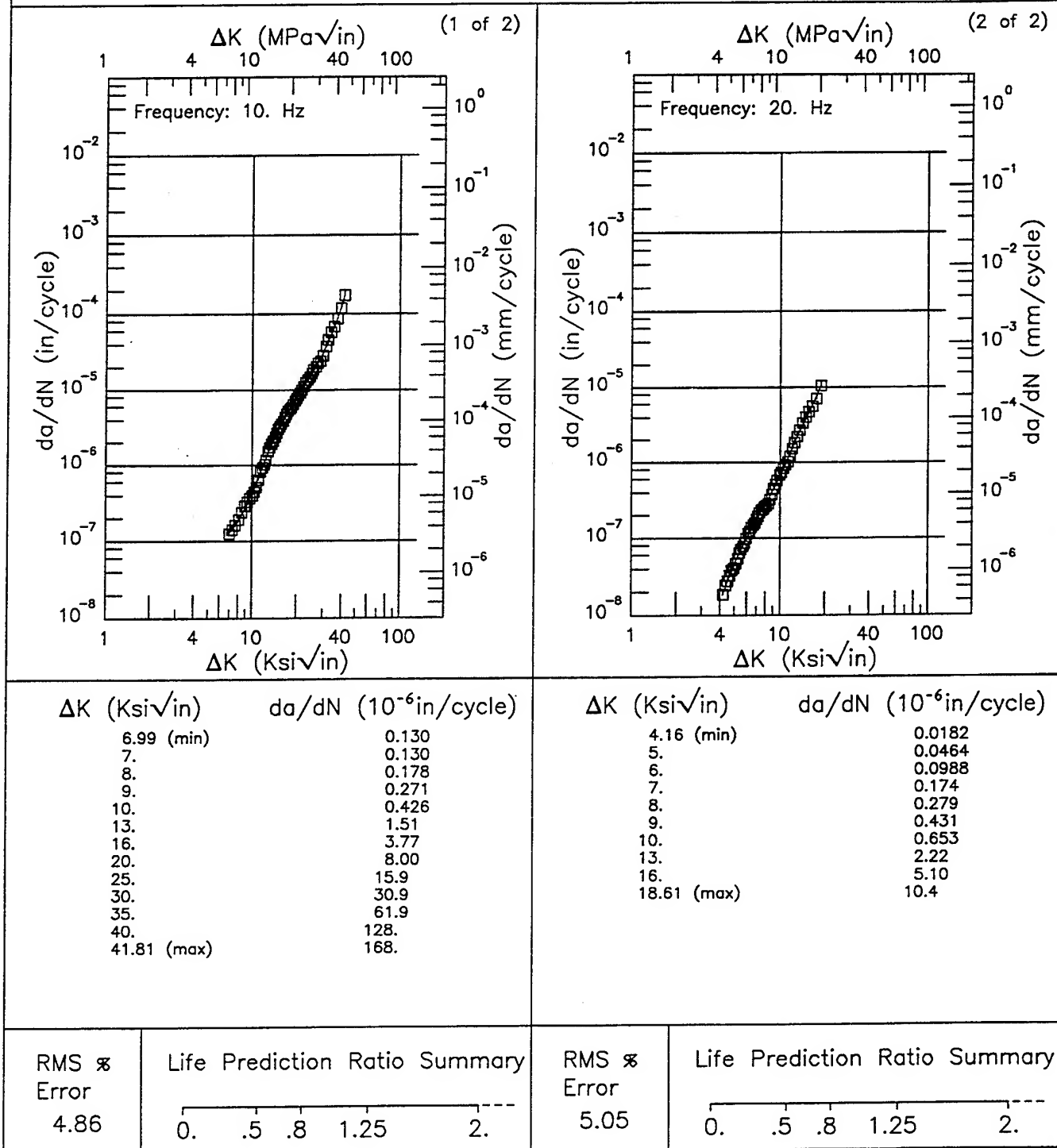


Figure 6.18.3.1.2

Condition/Ht: MA  
 Form: 2 in. Forging  
 Specimen Type: DCB  
 Orientation: L-T  
 Stress Ratio: 0.02  
 Frequency: 0.1 Hz

Yield Strength: 144 ksi  
 Ult. Strength: 151 ksi  
 Specimen Thk: 0.75 in.  
 Specimen Width: 5.5 in.  
 Ref: 84360

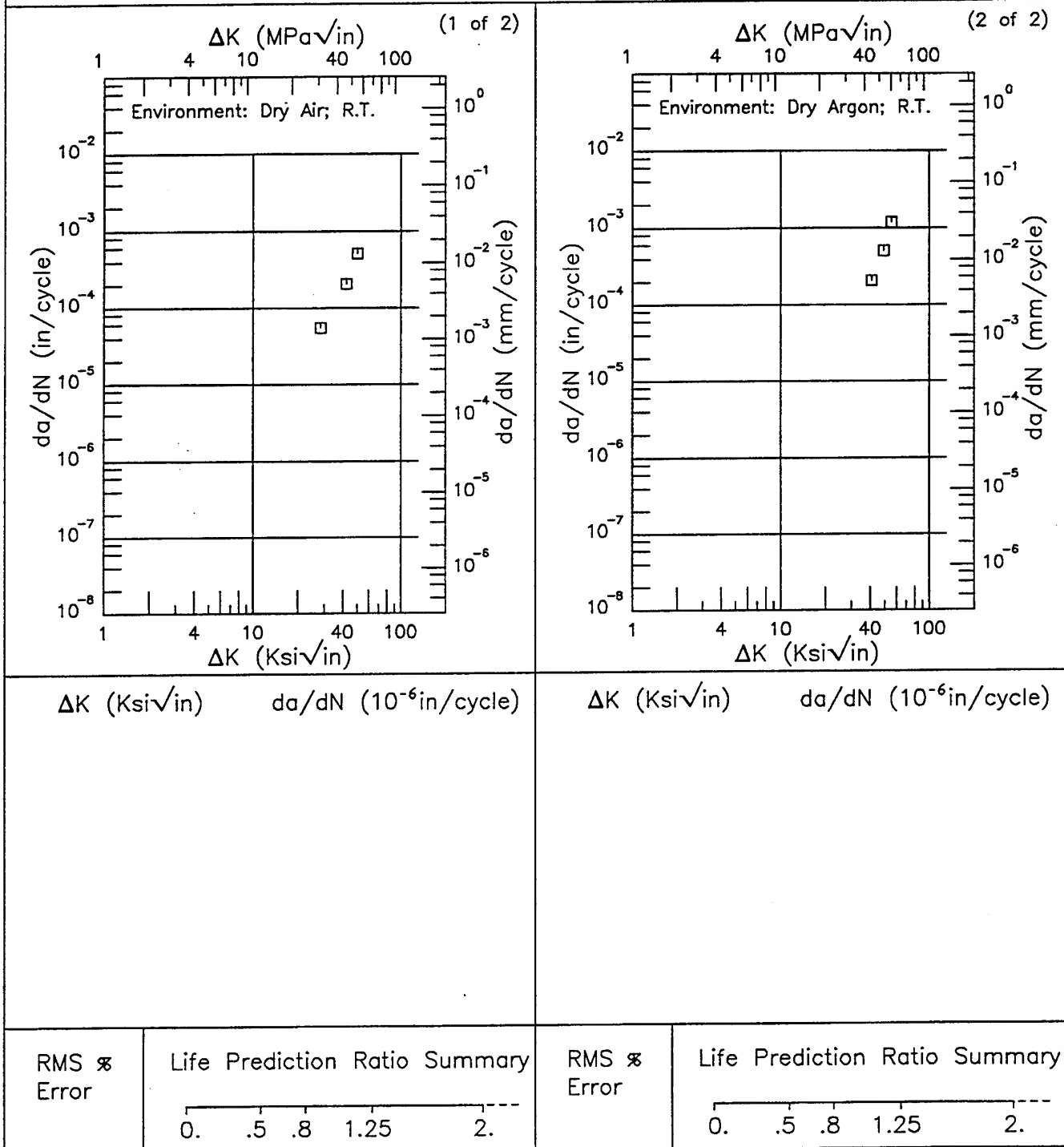
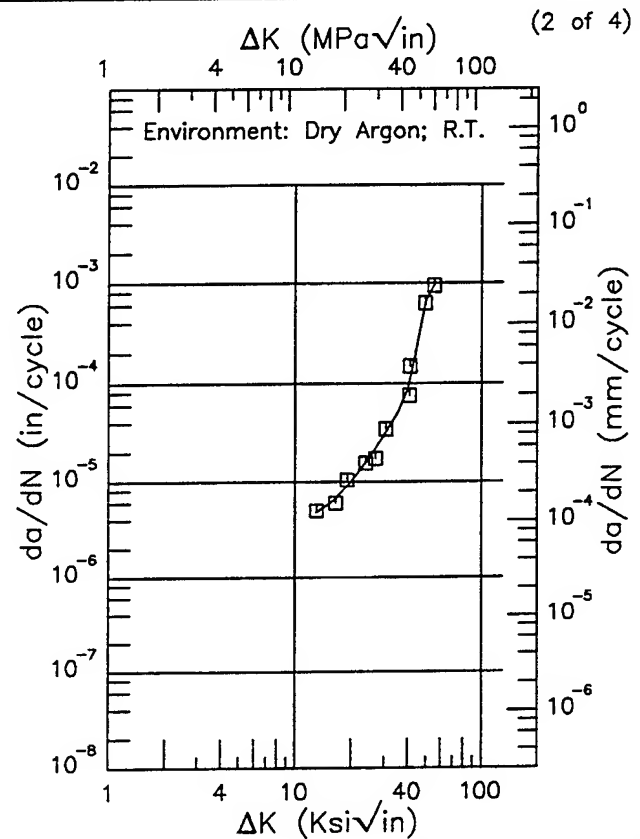
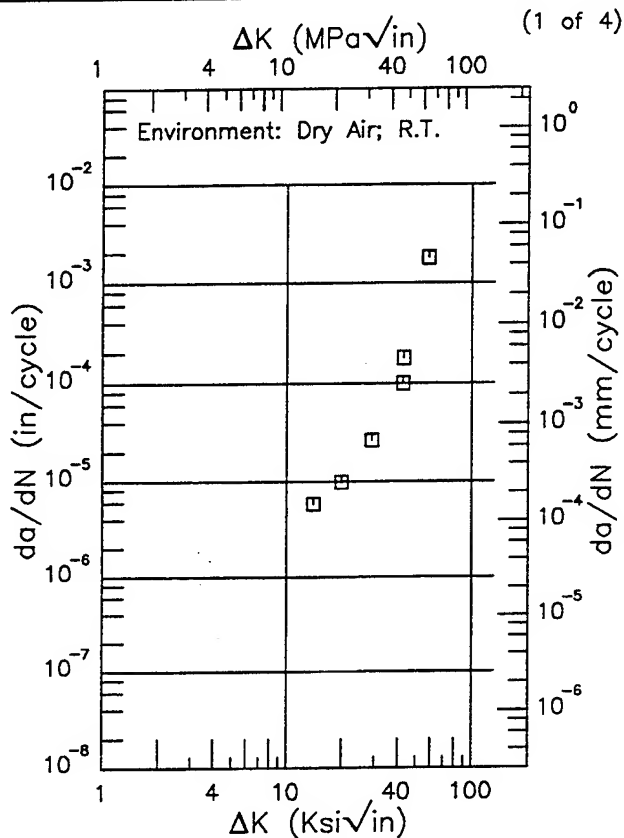


Figure 6.18.3.1.3

E | Ti-6Al-6V-2Sn |

Condition/Ht: MA  
Form: 2 in. Forging  
Specimen Type: DCB  
Orientation: L-T  
Stress Ratio: 0.02  
Frequency: 1 Hz

Yield Strength: 144 - 155 ksi  
Ult. Strength: 151 - 164 ksi  
Specimen Thk: 0.75 in.  
Specimen Width: 5.5 in.  
Ref: 84360



$\Delta K$  (Ksi√in)       $da/dN$  ( $10^{-6}$  in/cycle)

$\Delta K$  (Ksi√in)       $da/dN$  ( $10^{-6}$  in/cycle)

13.02 (min)	4.81
16.	6.34
20.	10.00
25.	17.7
30.	30.0
35.	48.9
40.	87.2
50.	674.
54.97 (max)	923.

RMS %  
Error

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error

17.35

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.18.3.1.4

Condition/Ht: MA  
Form: 2 in. Forging  
Specimen Type: DCB  
Orientation: L-T  
Stress Ratio: 0.02  
Frequency: 1 Hz

Yield Strength: 144 - 155 ksi  
Ult. Strength: 151 - 164 ksi  
Specimen Thk: 0.75 in.  
Specimen Width: 5.5 in.  
Ref: 84360

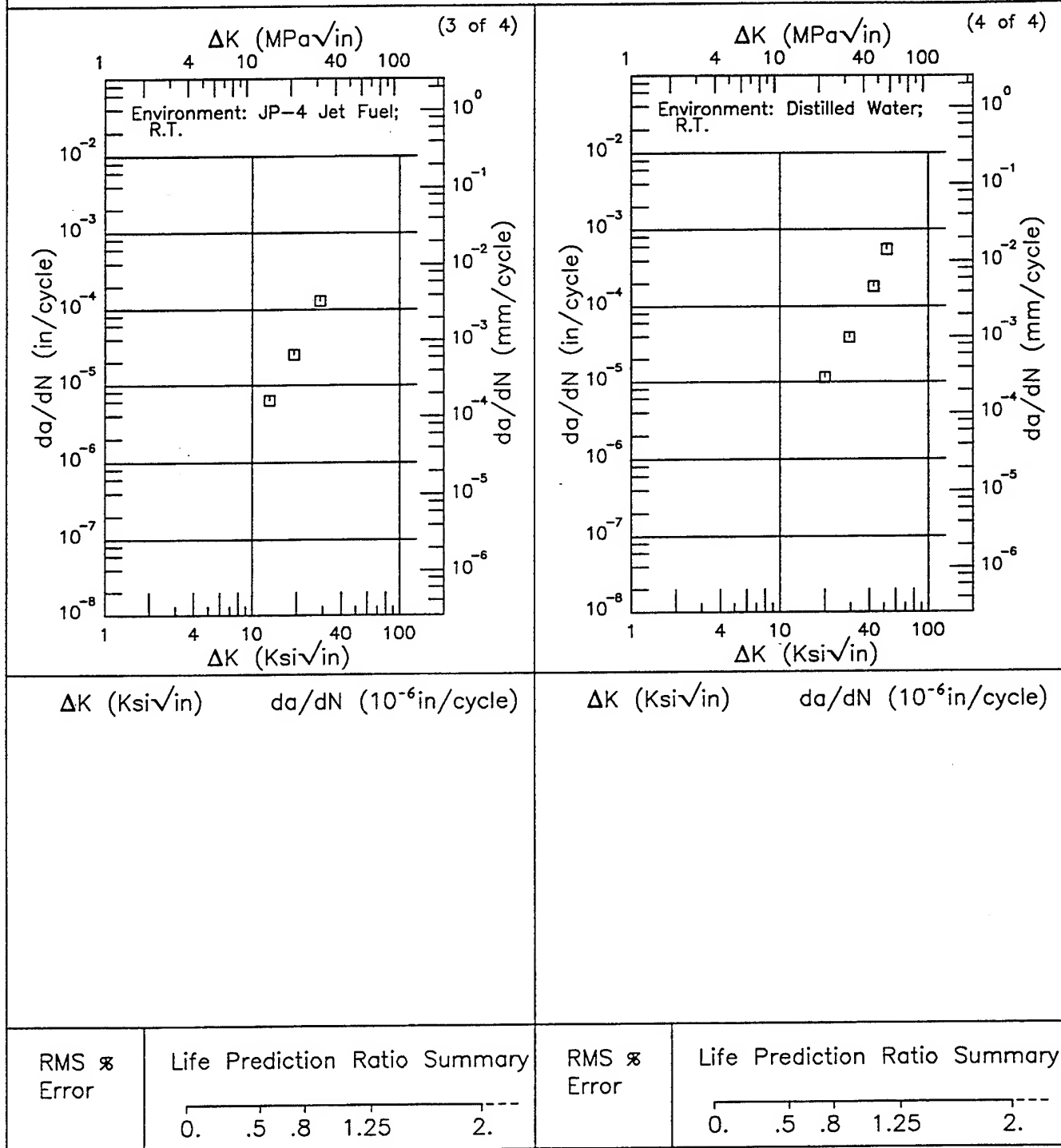


Figure 6.18.3.1.4 (Concluded)

E | Ti-6Al-6V-2Sn |

Condition/Ht: MA  
 Form: 2 in. Forging  
 Specimen Type: DCB  
 Orientation: L-T  
 Stress Ratio: 0.02  
 Frequency: 10 Hz

Yield Strength: 144 - 155 ksi  
 Ult. Strength: 151 - 164 ksi  
 Specimen Thk: 0.75 in.  
 Specimen Width: 5.5 in.  
 Ref: 84360

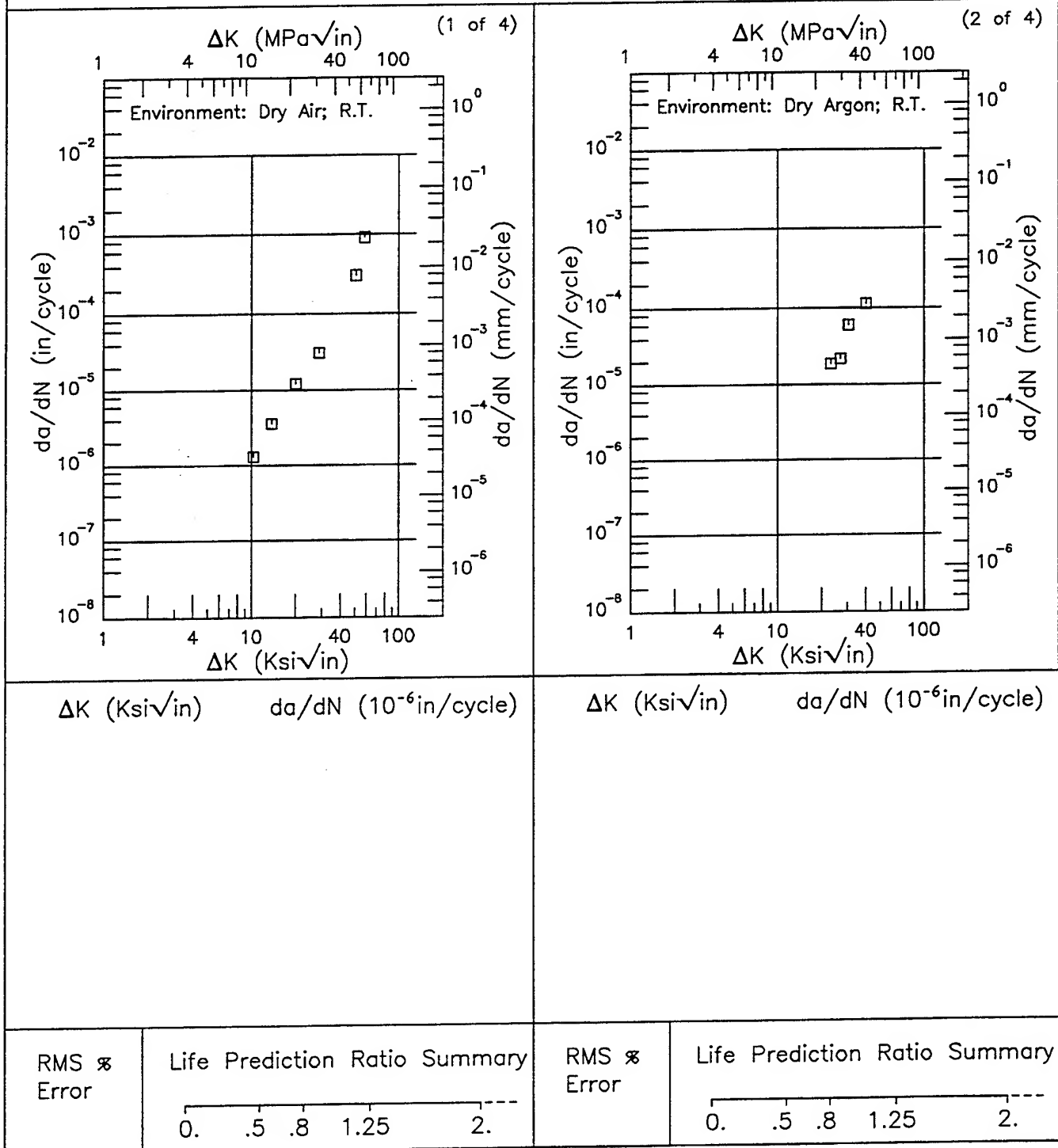


Figure 6.18.3.1.5

Condition/Ht: MA  
Form: 2 in. Forging  
Specimen Type: DCB  
Orientation: L-T  
Stress Ratio: 0.02  
Frequency: 10 Hz

Yield Strength: 144 - 155 ksi  
Ult. Strength: 151 - 164 ksi  
Specimen Thk: 0.75 in.  
Specimen Width: 5.5 in.  
Ref: 84360

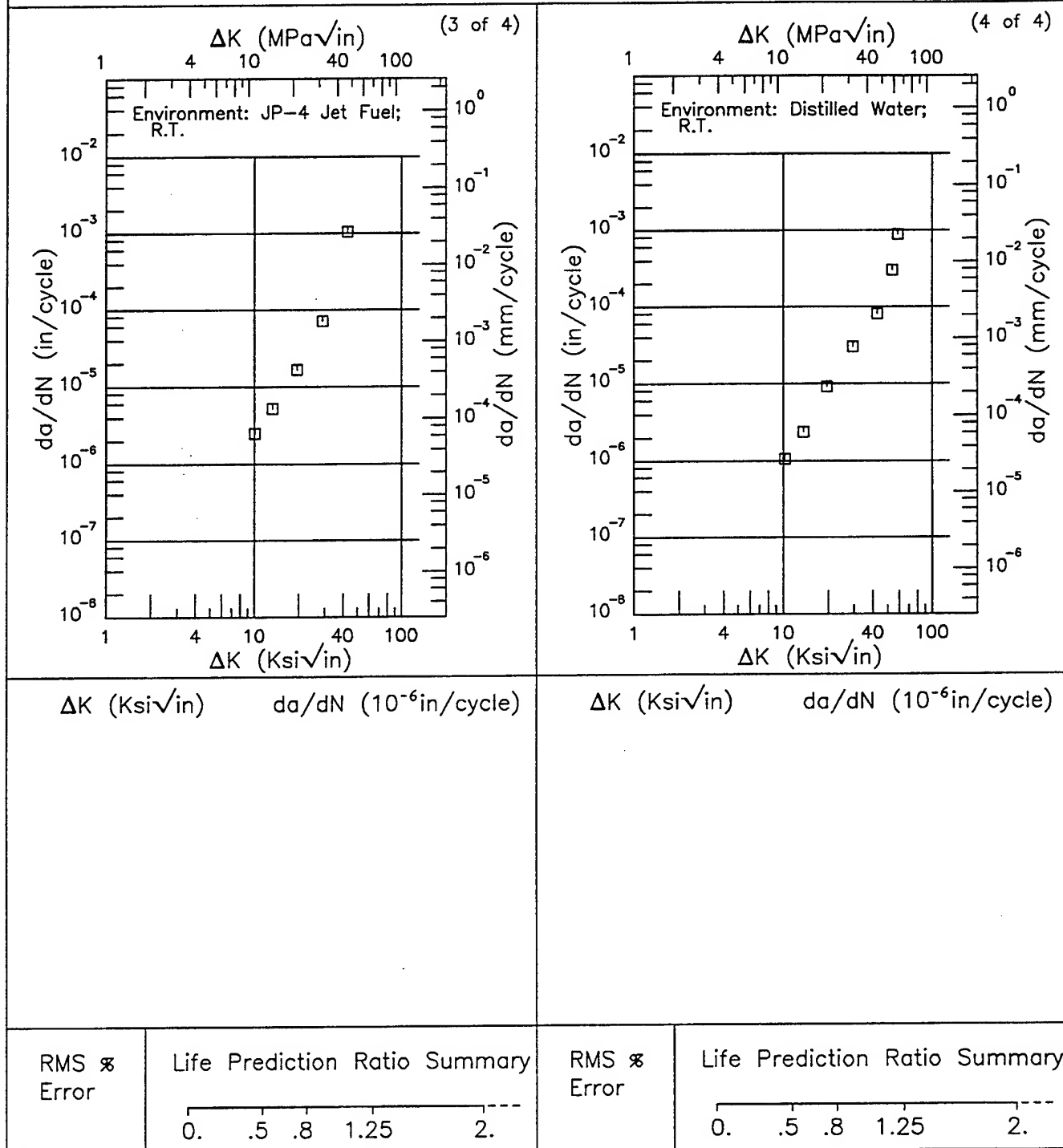
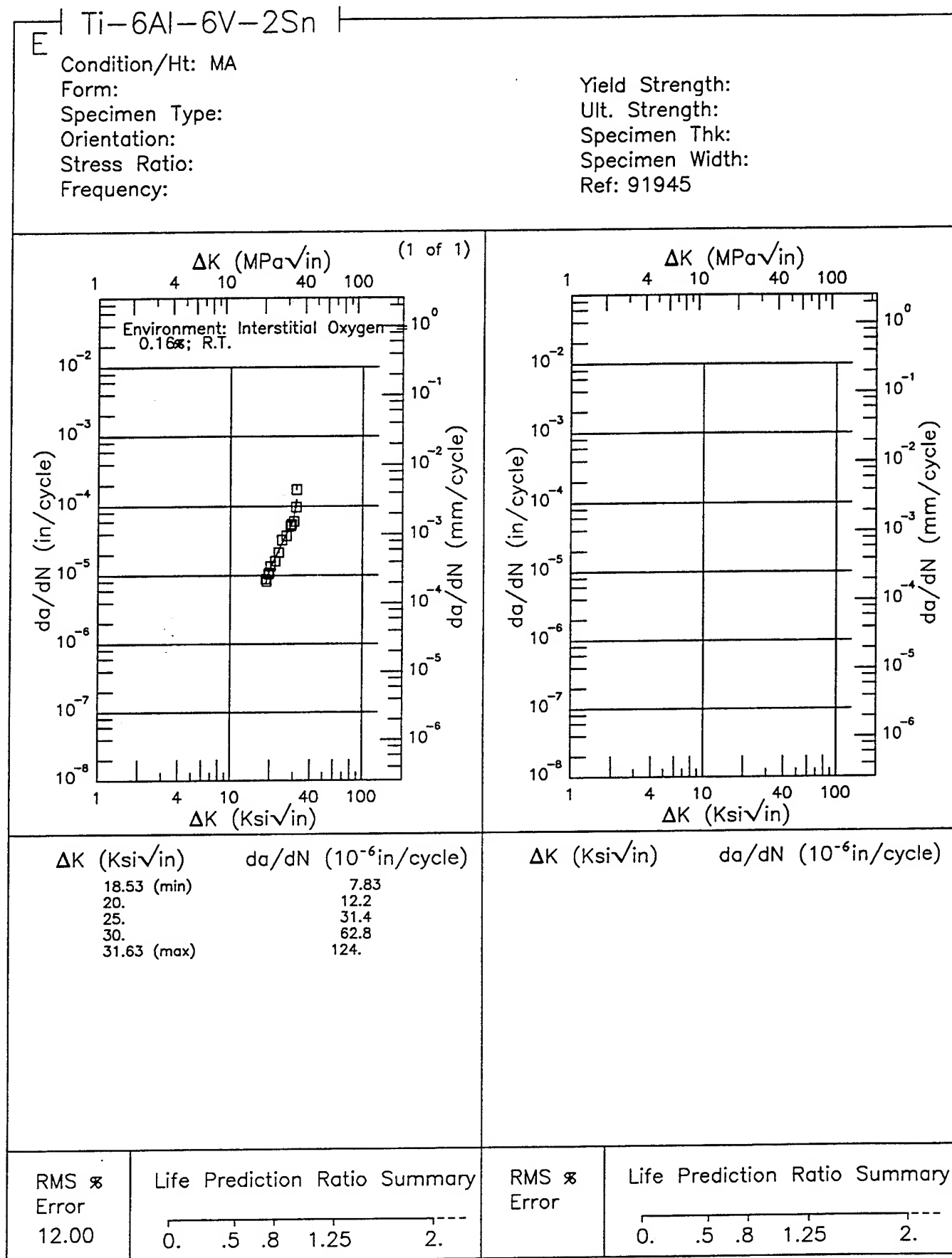


Figure 6.18.3.1.5 (Concluded)



**Figure 6.18.3.1.6**

Condition/Ht: RA

Form:

Specimen Type:

Orientation:

Stress Ratio:

Frequency:

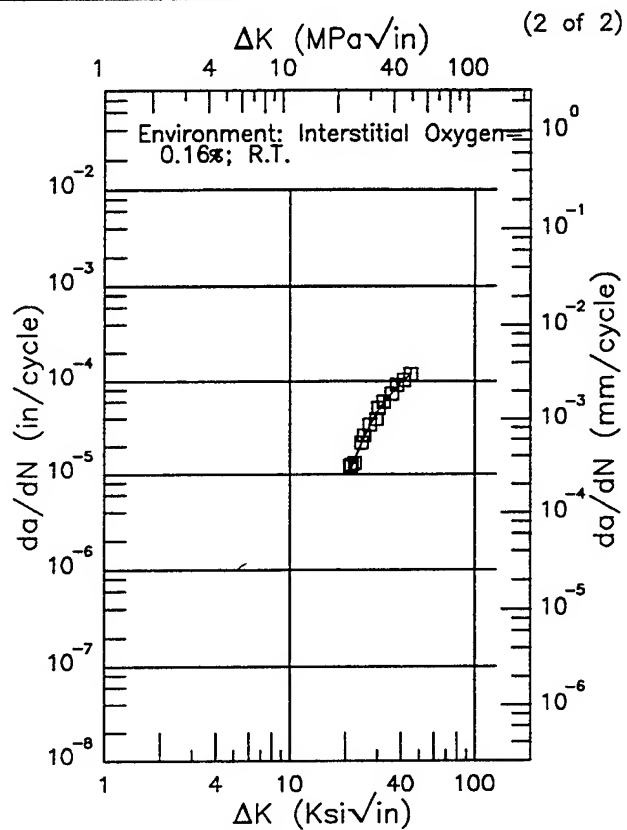
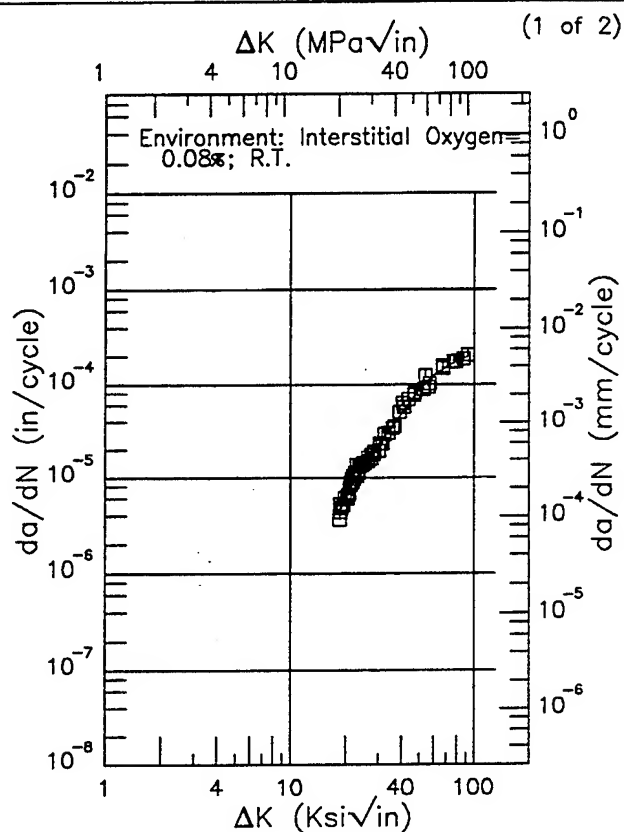
Yield Strength:

Ult. Strength:

Specimen Thk:

Specimen Width:

Ref: 91945



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
18.44 (min)	4.48
20.	6.34
25.	13.7
30.	22.8
35.	34.1
40.	49.0
50.	87.9
60.	124.
70.	151.
80.	177.
90.	195.
91.66 (max)	197.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
21.24 (min)	10.9
25.	23.7
30.	47.1
35.	71.6
40.	97.7
45.04 (max)	116.

RMS %  
Error

11.34

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

RMS %  
Error

6.60

Life Prediction Ratio Summary

0. .5 .8 1.25 2.---

Figure 6.18.3.1.7



EF | Ti-6Al-6V-2Sn |

Condition/Ht: STOA  
Form: 0.63 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.1

Yield Strength: 160 ksi  
Ult. Strength: 170 ksi  
Specimen Thk: 0.148 - 0.151 in.  
Specimen Width: 3 in.  
Ref: 86844

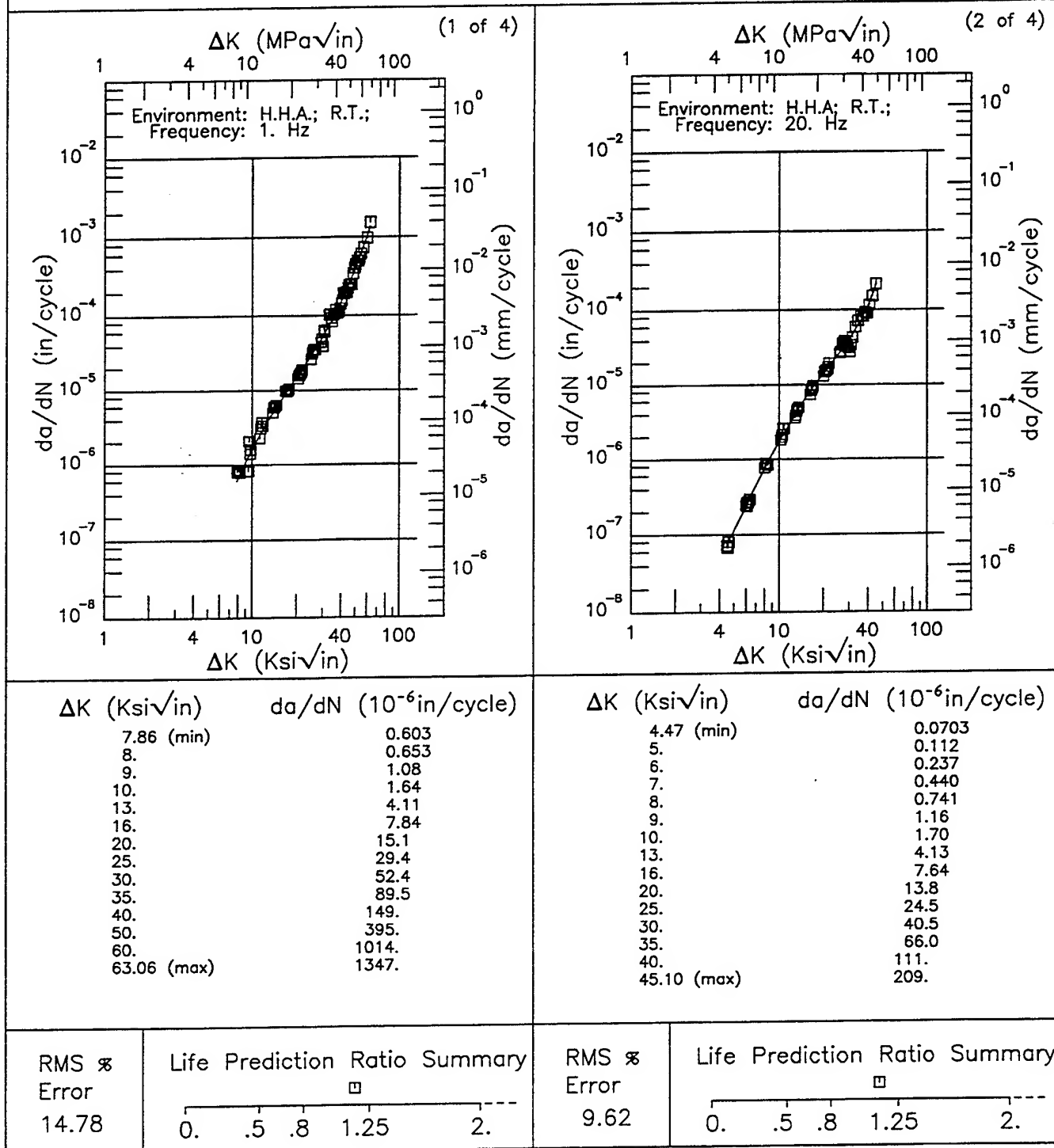
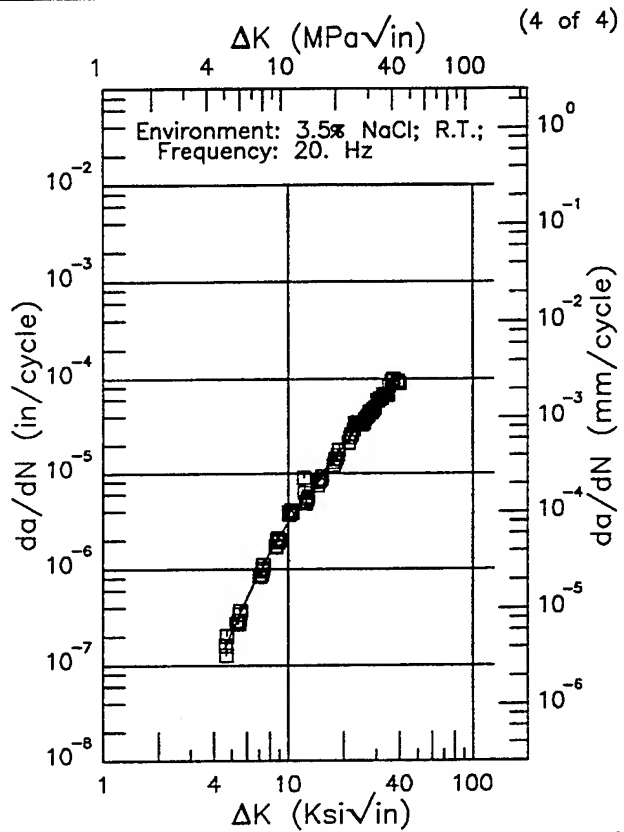
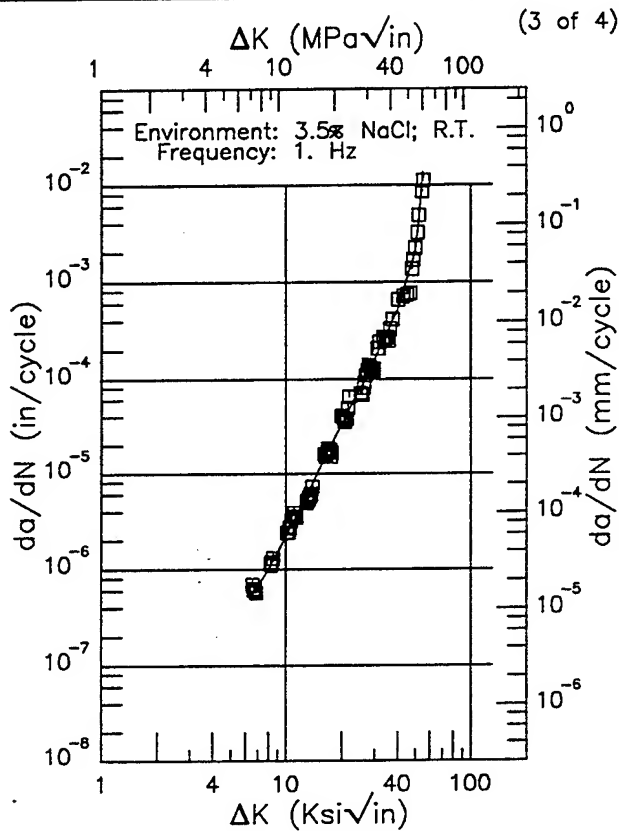


Figure 6.18.3.1.8

Condition/Ht: STOA  
Form: 0.63 in. Plate  
Specimen Type: CT  
Orientation: L-T  
Stress Ratio: 0.1

Yield Strength: 160 ksi  
Ult. Strength: 170 ksi  
Specimen Thk: 0.148 - 0.151 in.  
Specimen Width: 3 in.  
Ref: 86844



$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
6.57 (min)	0.552
7.	0.660
8.	0.999
9.	1.49
10.	2.19
13.	6.04
16.	13.9
20.	33.8
25.	80.2
30.	164.
35.	305.
40.	528.
50.	2094.
54.97 (max)	13672.

$\Delta K$ (Ksi√in)	$da/dN$ ( $10^{-6}$ in/cycle)
4.61 (min)	0.151
5.	0.223
6.	0.499
7.	0.916
8.	1.48
9.	2.19
10.	3.05
13.	6.46
16.	11.1
20.	19.5
25.	34.0
30.	53.7
35.	78.2
39.72 (max)	105.

RMS %  
Error  
14.53

Life Prediction Ratio Summary  
□  
0. .5 .8 1.25 2.

RMS %  
Error  
12.57

Life Prediction Ratio Summary  
□  
0. .5 .8 1.25 2.

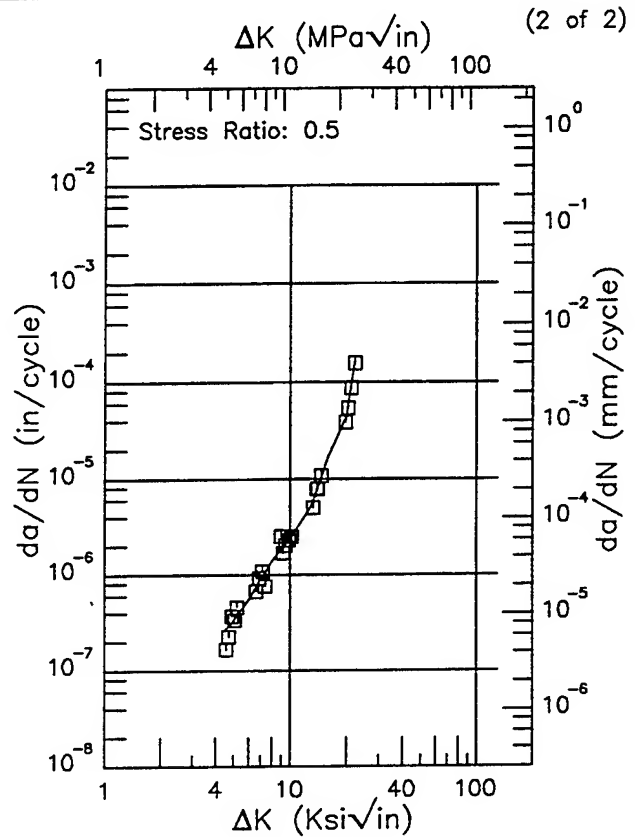
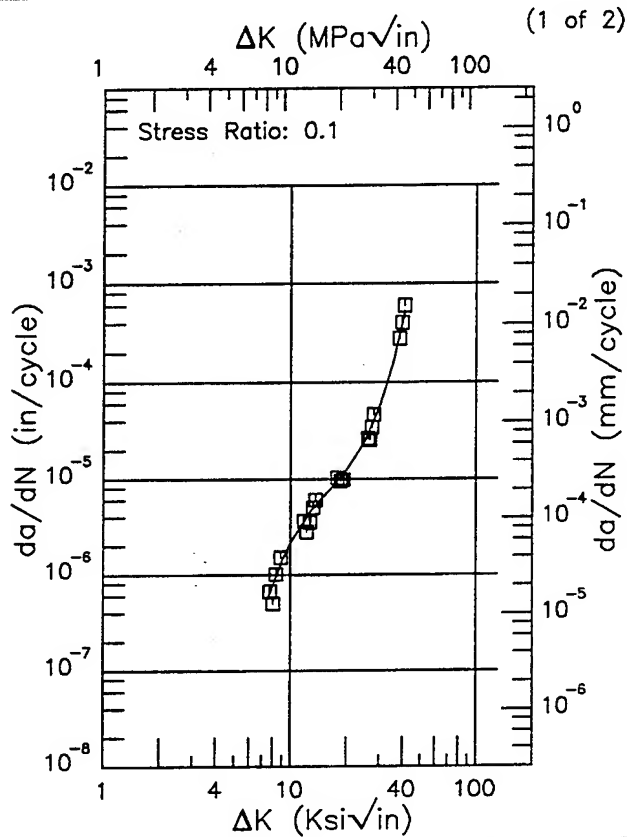
Figure 6.18.3.1.8 (Concluded)

R

Ti-6Al-6V-2Sn

Condition/Ht: STOA  
 Form: 0.38 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: T-L  
 Frequency: 10 Hz  
 Environment: H.H.A.; RT

Yield Strength: 160.3 ksi  
 Ult. Strength: 167.8 ksi  
 Specimen Thk: 0.375 in.  
 Specimen Width: 5 in.  
 Ref: 90981



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
7.71 (min)	0.615
8.	0.764
9.	1.40
10.	2.16
13.	4.71
16.	7.45
20.	12.4
25.	24.7
30.	56.3
35.	146.
40.	421.
41.04 (max)	531.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
4.54 (min)	0.271
5.	0.332
6.	0.550
7.	0.896
8.	1.35
9.	1.87
10.	2.37
13.	5.27
16.	16.9
20.	44.0
22.27 (max)	172.

RMS %  
 Error  
 15.21

Life Prediction Ratio Summary

0. .5 .8 1.25 2.

RMS %  
 Error  
 16.67

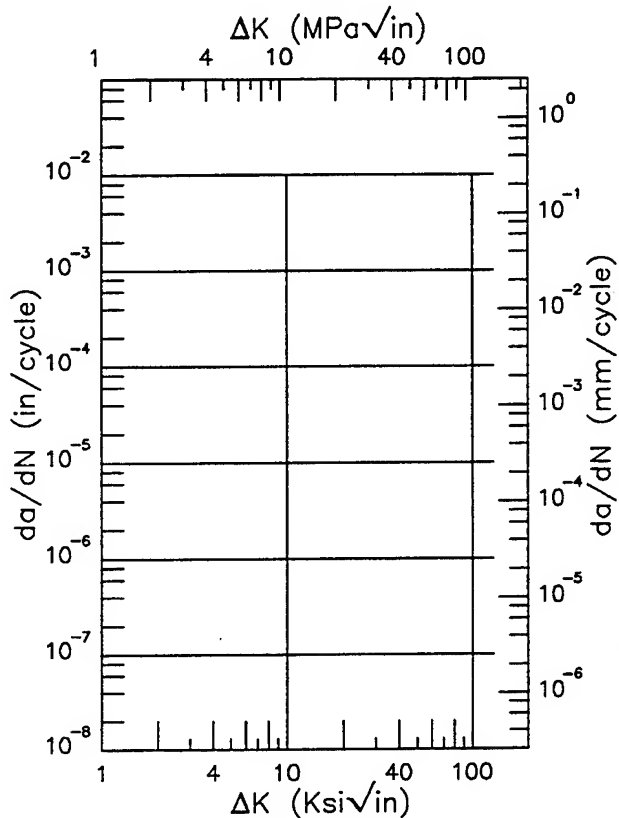
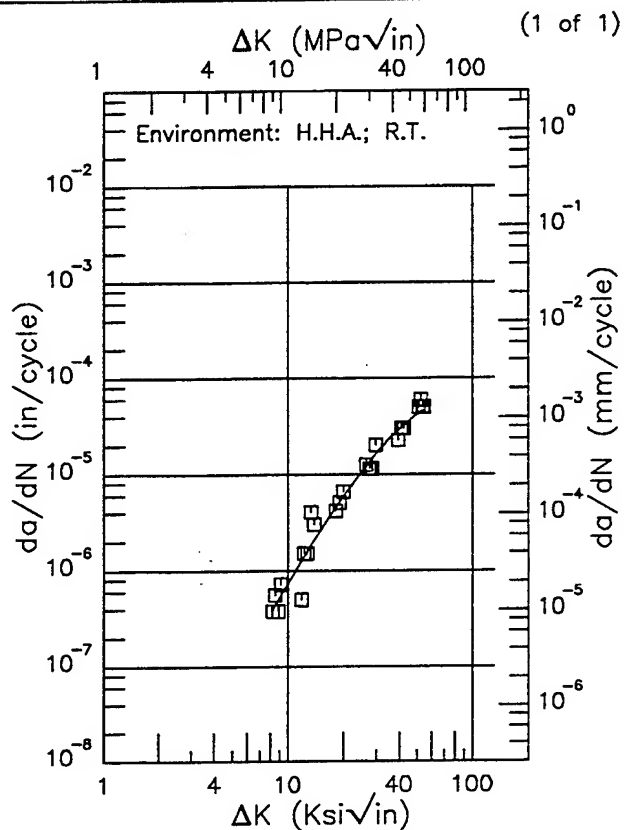
Life Prediction Ratio Summary

0. .5 .8 1.25 2.

Figure 6.18.3.1.9

Condition/Ht: STOA  
 Form: 0.13 in. Plate  
 Specimen Type: CCP (max load specified)  
 Orientation: T-L  
 Stress Ratio: 0.1  
 Frequency: 10 Hz

Yield Strength: 137.4 ksi  
 Ult. Strength: 143 ksi  
 Specimen Thk: 0.125 in.  
 Specimen Width: 5 in.  
 Ref: 90981



$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.20 (min)	0.390
9.	0.525
10.	0.734
13.	1.67
16.	3.15
20.	5.98
25.	10.8
30.	16.7
35.	23.2
40.	29.9
50.	42.3
54.31 (max)	46.9

$\Delta K$  (Ksi $\sqrt{\text{in}}$ )       $da/dN$  ( $10^{-6}$  in/cycle)

RMS %  
 Error  
 34.05

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

RMS %  
 Error

Life Prediction Ratio Summary  

 0. .5 .8 1.25 2.

Figure 6.18.3.1.10

E

Ti-6Al-6V-2Sn

Condition/Ht: STOA  
Form: 0.38 in. Plate  
Specimen Type: CCP (max load specified)  
Orientation: T-L  
Stress Ratio: 0.1  
Frequency: 0.1 Hz

Yield Strength: 160.3 ksi  
Ult. Strength: 167.8 ksi  
Specimen Thk: 0.375 in.  
Specimen Width: 5 in.  
Ref: 90981

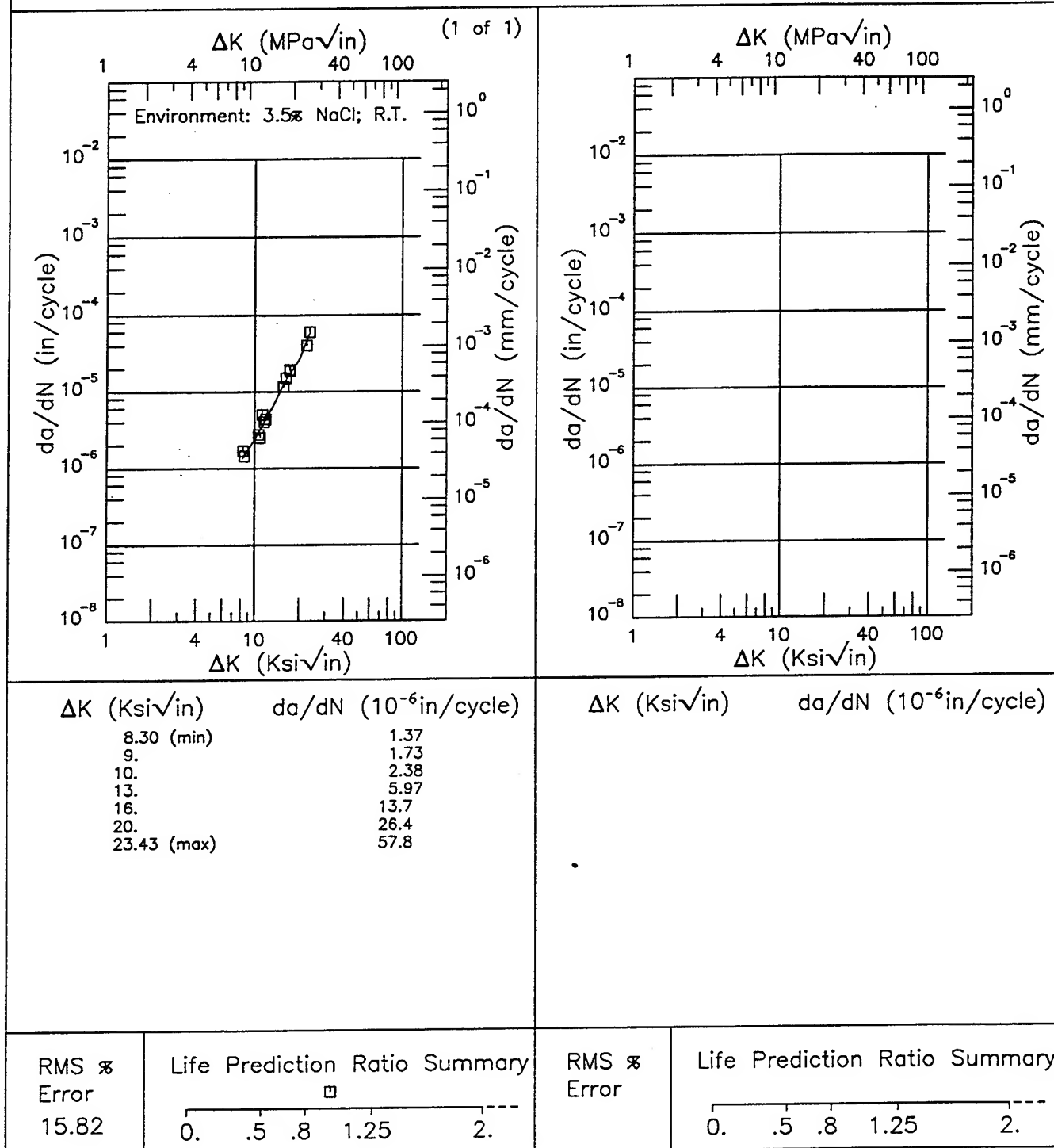


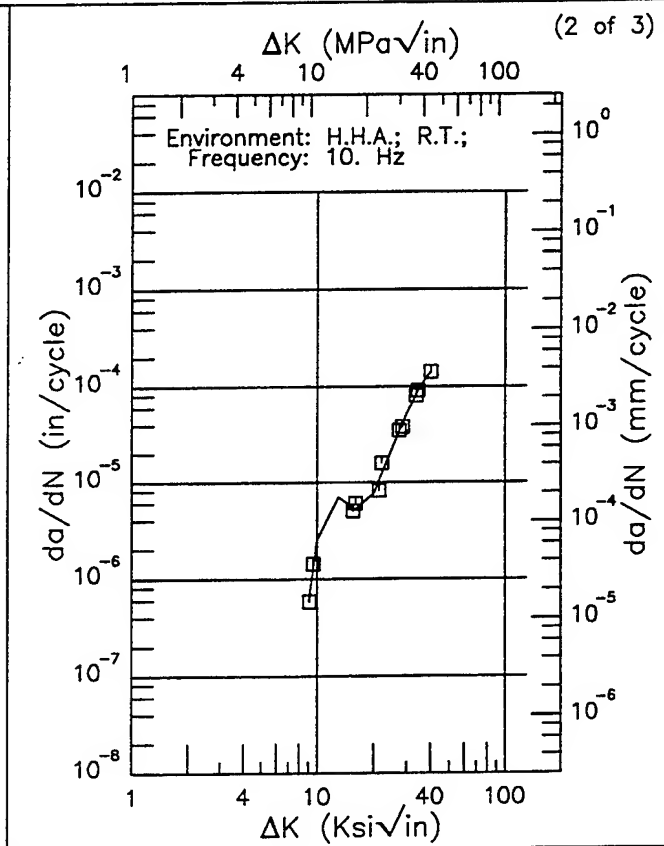
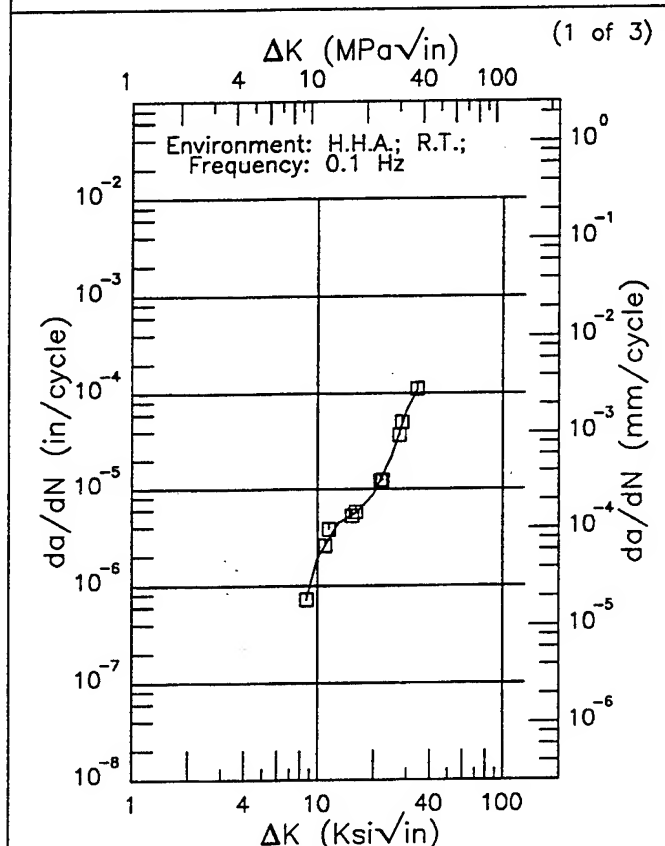
Figure 6.18.3.1.11

**This page intentionally left blank**

EF | Ti-6Al-6V-2Sn |

Condition/Ht: STOA  
 Form: 0.38 in. Plate  
 Specimen Type: PTSF (max stress specified)  
 Orientation: L-S  
 Stress Ratio: 0.1

Yield Strength: 130 ksi  
 Ult. Strength: 167.2 ksi  
 Specimen Thk: 0.372 - 0.374 in.  
 Specimen Width: 5 in.  
 Ref: 90981



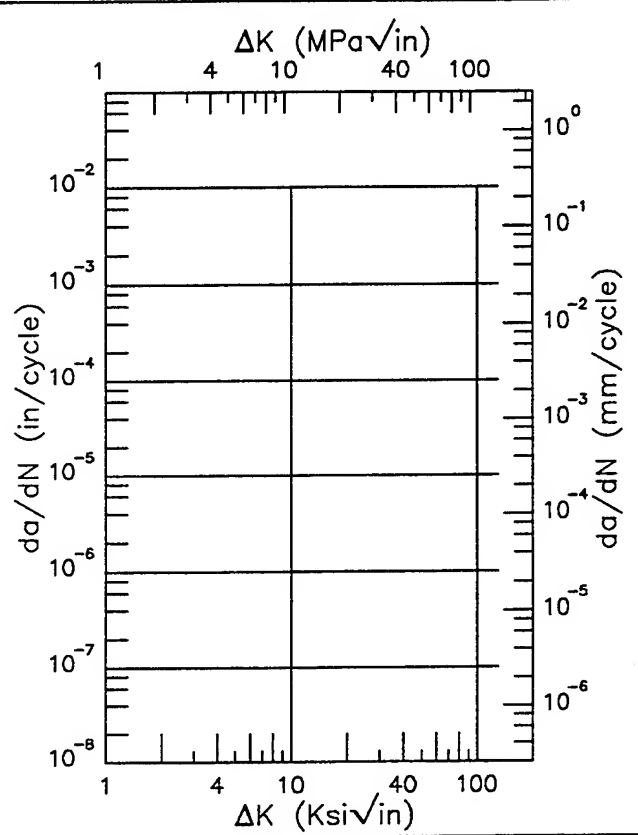
$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
8.70 (min)	0.708
9.	0.949
10.	1.94
13.	4.44
16.	5.64
20.	8.89
25.	22.6
30.	65.9
34.23 (max)	110.

$\Delta K$ (Ksi $\sqrt{\text{in}}$ )	$da/dN$ ( $10^{-6}$ in/cycle)
9.04 (min)	0.592
10.	2.53
13.	7.01
16.	5.18
20.	7.63
25.	22.0
30.	51.7
35.	96.5
39.96 (max)	140.

RMS % Error	Life Prediction Ratio Summary	RMS % Error	Life Prediction Ratio Summary
9.58	0. .5 .8 1.25 2. ---	12.37	0. .5 .8 1.25 2. ---

Figure 6.18.3.1.12

Yield Strength: 130 ksi  
Ult. Strength: 167.2 ksi  
Specimen Thk: 0.372 - 0.374 in.  
Specimen Width: 5 in.  
Ref: 90981


$$\Delta K \text{ (Ksi}\sqrt{\text{in}}) \quad da/dN \text{ (10}^{-6}\text{in/cycle)}$$

Life Prediction Ratio Summary

0. .5 .8 1.25 2. ---

**Figure 6.18.3.1.12 (Concluded)**



R

Ti-6Al-6V-2Sn

Condition/Ht: STOA

Form: 0.38 in. Plate

Specimen Type: PTSF (max stress specified)

Orientation: T-S

Frequency: 0.1 Hz

Environment: H.H.A.; RT

Yield Strength: 130 ksi

Ult. Strength: 167.2 ksi

Specimen Thk: 0.373 - 0.374 in.

Specimen Width: 5 in.

Ref: 90981

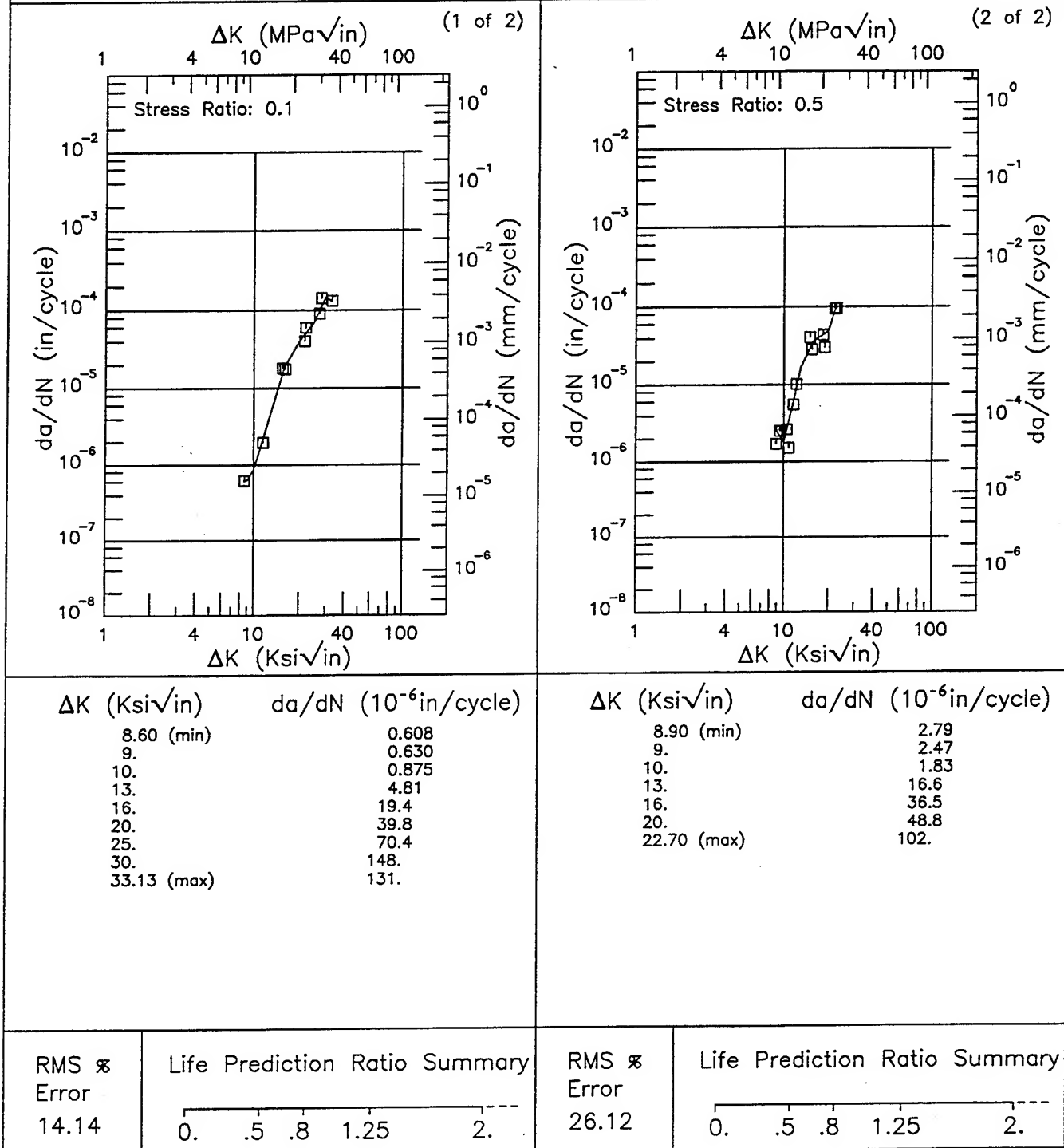


Figure 6.18.3.1.13

Condition/Ht: STOA  
 Form: 0.38 in. Plate  
 Specimen Type: PTSF (max stress specified)  
 Orientation: T-S  
 Frequency: 1 Hz  
 Environment: 3.5% NACL; RT

Yield Strength: 156.5 ksi  
 Ult. Strength: 167.8 ksi  
 Specimen Thk: 0.375 in.  
 Specimen Width: 5 in.  
 Ref: 90981

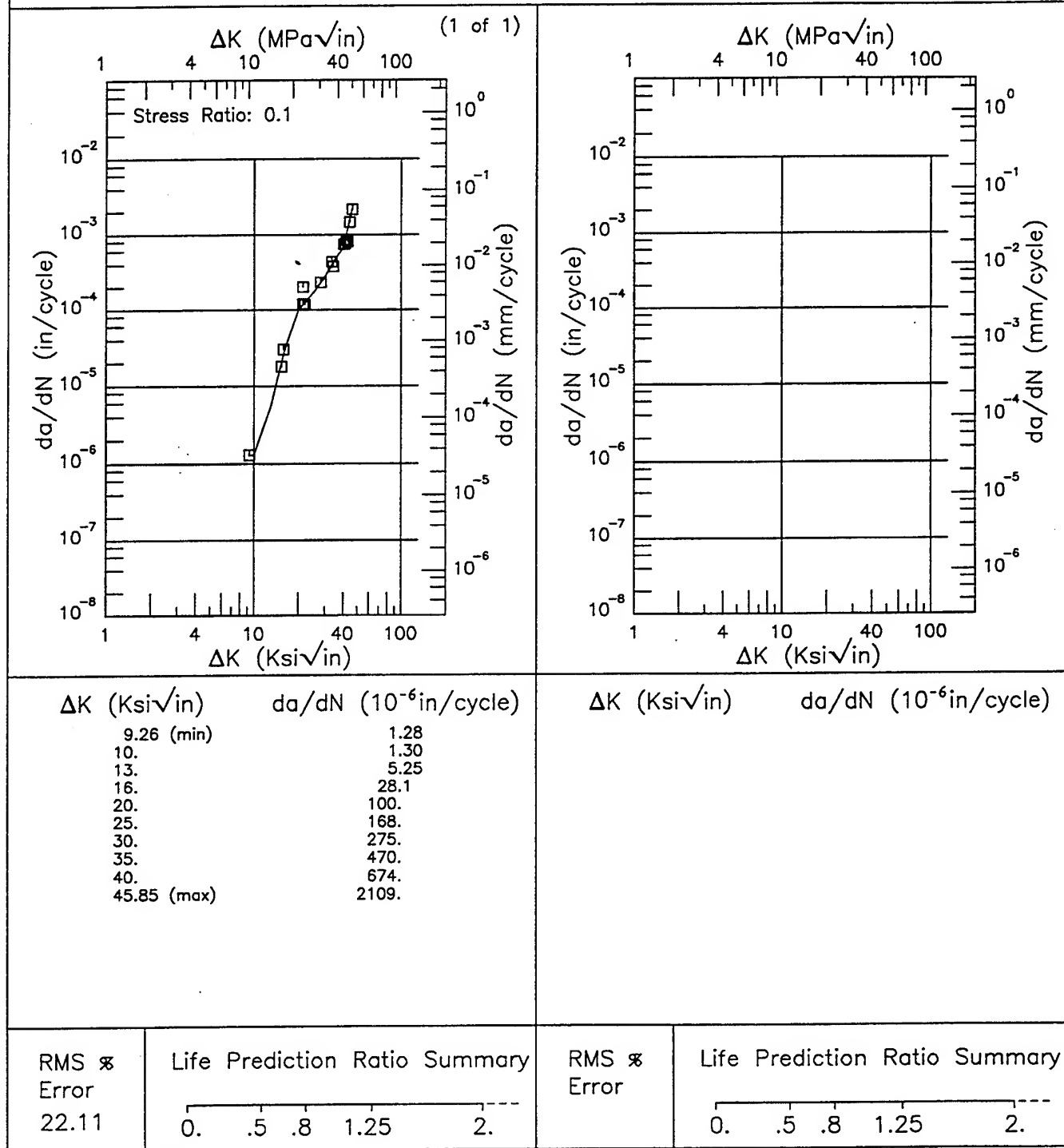


Figure 6.18.3.1.14  
 6-513

Ti-6Al-6V-2Sn

Condition/Ht: 1300F 2HR  
 Form: 2 in. Forging  
 Specimen Type: TDCB  
 Orientation: L-T  
 Yield Strength: 146 ksi  
 Ult. Strength:

Specimen Thk: 1.25 in.  
 Specimen Width: 5.5 in.  
 A<sub>0</sub>:  
 K<sub>I</sub><sub>sec</sub>: 31 - 32 ksi  
 Ref: 84360

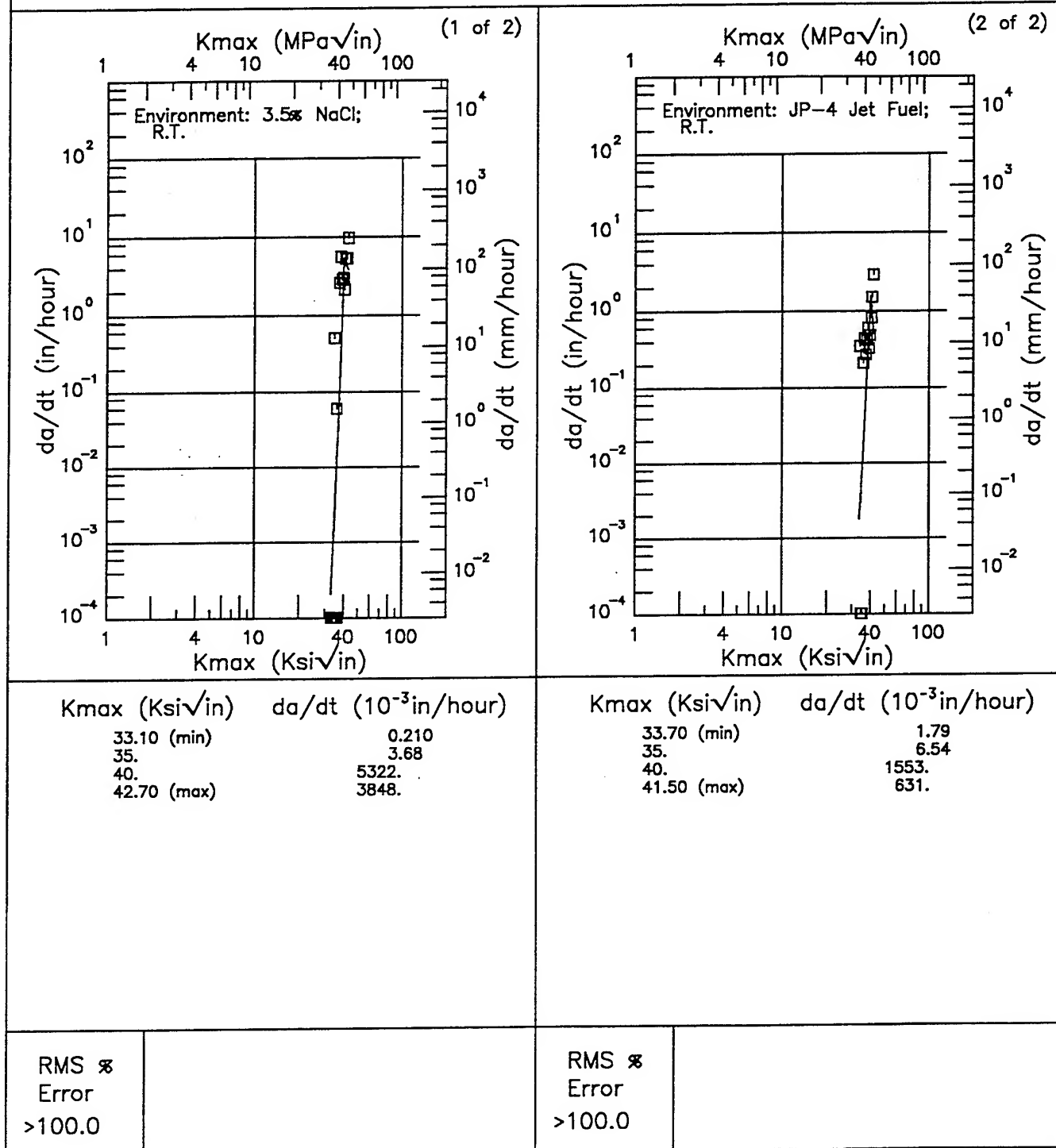


Figure 6.18.3.2

TABLE 6.19.3.3

(1 of 1)

**K<sub>Isec</sub> SUMMARY FOR TITANIUM ALLOY Ti-6Al-6V-2.5Sn**

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	K <sub>Q</sub> (Ksi√in)	K <sub>Isec</sub> (Ksi√in)	Test Time (min)	Test Date	Reference
						Design	Width (in)	Thick (in)							
Unspecified	P	R.T.	---	186	3.5% NaCl	CANT	---	---	---	---	55	21	---	1967	70887
1000°F 2hr AC	F	R.T.	L-T	155.1	JP-4 Fuel	TDCB	5	1.25	2.2	---	57.1	30.5	---	1971	84360
1300°F 2hr AC	F	R.T.	L-T	146.2	3.5% NaCl	TDCB	5	1.25	2.2	---	47.3	32.4	---	1971	84360
1550°F 1hr WQ 900°F 4hr AC	P	R.T.	T-S	179.6	3.5% NaCl	CANT*	1	0.75	1	---	55	21	---	1967	70931

\* asterisk in specimen design column indicates that specimens are side-grooved

TABLE 6.20.2.1

TITANIUM Ti-6Al-2Sn-4Zr-6Mo K <sub>1c</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>1c</sub> TYS) <sup>a</sup> (in.)	K <sub>1c</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>1c</sub> (Ksi√in.)	K <sub>1c</sub> MEAN	STAN DEV		
50% PRIMARY ALPHA	Forging	2.00	R.T.	...	153.0	...	2.000	...	...	0.21	43.96	...	...	...	RI005
BETA PROCESSED	Forging	2.00	R.T.	...	156.6	...	2.000	...	...	0.52	71.44	...	...	...	RI005
BU B FIN-10MA BETA UPSET BETA FINISHED 10% PRIMARY ALPHA MILL ANNEALED 1300 F 1 HR AC	Forging	2.75	R.T.	...	148.0	2.000	1.000	CT	1.000	0.09	28.50	27.9	1.0	1974	88962 (1)
		2.75			148.0	2.000	1.000	CT	1.000	0.08	26.70			1974	88962 (1)
		2.75			148.0	2.000	1.000	CT	1.000	0.09	28.50			1974	88962 (1)
BU B FIN-10STA BETA UPSET BETA FINISHED 10% PRIMARY ALPHA SOLUTION TREATED	Forging	2.75	R.T.	...	162.0	2.000	1.000	CT	1.000	0.10	31.30	31.1	0.6	1974	88962 (1)
		2.75			162.0	2.000	1.000	CT	1.000	0.09	30.40			1974	88962 (1)
		2.75			162.0	2.000	1.000	CT	1.000	0.10	31.60			1974	88962 (1)
BU B FIN-10STO BETA UPSET BETA FINISHED 10% PRIMARY ALPHA SOLUTION TREATED & OVERAGED 1625F 1 HR AC 1300F 1 HR AC	Forging	2.75	R.T.	...	148.0	2.000	1.000	CT	1.000	0.08	27.10	28.4	1.8	1974	88962 (1)
		2.75			148.0	2.000	1.000	CT	1.000	0.10	29.70			1974	88962 (1)
BU B FIN-50MA BETA UPSET BETA FINISHED 50% PRIMARY ALPHA MILL ANNEALED 1300F 1 HR AC	Forging	2.75	R.T.	...	154.0	2.000	1.000	CT	1.000	0.05	22.70	23.8	1.6	1974	88962 (1)
		2.75			154.0	2.000	1.000	CT	1.000	0.06	24.90			1974	88962 (1)
BU B FIN-50STA BETA UPSET BETA FINISHED 50% PRIMARY ALPHA SOLUTION TREATED & AGED 1625F 1 HR AC 1100F 8 HR AC	Forging	2.75	R.T.	...	167.0	2.000	1.000	CT	1.000	0.05	24.00	24.4	0.6	1974	88962 (1)
		2.75			167.0	2.000	1.000	CT	1.000	0.05	24.80			1974	88962 (1)

NOTES: (1) COMP. DISK

TABLE 6.20.2.1 (CONCLUDED)

2 of 2

TITANIUM Ti-6Al-2Sn-4Zr-6Mo K <sub>1c</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (KSI)	SPECIMEN			CRACK LENGTH (in.) A	2.5 * (K <sub>1c</sub> /TYS) <sup>1</sup> (in.)	K <sub>1c</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>1c</sub> (KSI/in.)	K <sub>1c</sub> MEAN	STAN DEV		
BU HABFIN10STA BETA UPSET HI ALPHA-BETA FINISHED 10% REDUCTION SOLUTION		2.75			159.0	2.000	1.000	CT	1.000	0.16	40.50			1974	88962 (1)
	Forging	2.75	R.T.	...	159.0	2.000	1.000	CT	1.000	0.18	42.30	41.4	0.9	1974	88962 (1)
		2.75			159.0	2.000	1.000	CT	1.000	0.17	41.50			1974	88962 (1)
BU HABFIN30STA BETA UPSET HI ALPHA-BETA FINISHED 30% REDUCTION SOLUTION TREATED		2.75			161.0	2.000	1.000	CT	1.000	0.13	36.40			1974	88962 (1)
	Forging	2.75	R.T.	...	161.0	2.000	1.000	CT	1.000	0.15	38.90	37.4	1.3	1974	88962 (1)
		2.75			161.0	2.000	1.000	CT	1.000	0.13	36.90			1974	88962 (1)
BU LABFIN10STA BETA UPSET LO ALPHA-BETA FINISHED 10% REDUCTION SOLUTION TREATED		2.75			155.0	2.000	1.000	CT	1.000	0.21	44.80			1974	88962 (1)
	Forging	2.75	R.T.	...	155.0	2.000	1.000	CT	1.000	0.20	43.60	44.7	1.1	1974	88962 (1)
		2.75			155.0	2.000	1.000	CT	1.000	0.22	45.80			1974	88962 (1)
STA-1625F 2 HR AC 1100F 8 HR AC		---			163.0	2.000	1.000	CT	1.000	0.10	32.40			1974	88962 (2)
		---			163.0	2.000	1.000	CT	1.000	0.10	32.70			1974	88962 (2)
		---			163.0	2.000	1.000	CT	1.000	0.09	31.60			1974	88962 (2)
	Forging	---	R.T.	...	166.0	2.000	1.000	CT	1.000	0.08	29.20	31.2	1.3	1974	88962 (3)
		---			166.0	2.000	1.000	CT	1.000	0.08	30.20			1974	88962 (3)
		---			166.0	2.000	1.000	CT	1.000	0.09	31.20			1974	88962 (3)

NOTES: (1) COMP. DISK  
(2) COMP. DISK COARSE GRAIN SIZE  
(3) COMP. DISK FINE GRAIN SIZE

TABLE 6.21.1.2.1

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**TI-8Al-1Mo-1V AT ROOM TEMPERATURE**

**ORIENTATION: L-T**                      **ENVIRONMENT: Lab Air**

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{\text{in}}$ )					
				2.5	6.0	10.0	20.0	50.0	100.0
1825F 1HR AC 1350F 2HRS AC	UNSPECIFIED	0.	0.33				10.22		
		0.04	0.33			0.51			
DA	SHEET	0.1	43				7.92	238.6	
		0.25	1-30					160.57	
		0.67	1-30			2.54			
MA	SHEET	0.1	43				7.3		
UNSPECIFIED	SHEET	0.02	0.1-12			2.28	13.54	144.35	

TABLE 6.21.1.2.2

**FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF STRESS INTENSITY FACTOR  $\Delta K$**   
**Ti-8Al-1Mo-1V AT ROOM TEMPERATURE**

ORIENTATION: C-R

ENVIRONMENT: Lab Air

CONDITION/ HEAT TREATMENT	PRODUCT FORM	R	FREQ (Hz)	FCGR ( $10^{-6}$ in/cycle)					
				$\Delta K$ Level (Ksi $\sqrt{in}$ )					
				2.5	5.0	10.0	20.0	50.0	100.0
1830F 1HR WQ 1100F 8HRS AC	FORGING	0.1	30		0.13	1.14			



TABLE 6.21.2.1

TITANIUM Ti-8Al-1Mo-1V $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 * ( $K_{Ic}$ /TS) <sup>a</sup> (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ (Ksi√in.)	$K_{Ic}$ MEAN	STAN DEV		
1830F 1 HR WQ 1100F 8 HRS AC	Forging	---	R.T.	C-R	142.0	2.500	0.500	---	---	0.18	38.22	---	---	1977	PW002

TABLE 6.21.2.2

TI-8AL-1MO-1V K <sub>C</sub>																				
CONDITION HEAT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS			K <sub>app</sub>			K <sub>C</sub>			DATE	REFER
	FORM	THICK (In.)				WIDTH (In.) W	THICK (In.) B	INIT (In.) 2a <sub>i</sub>	FINAL (In.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>s</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi√In.) K <sub>app</sub>	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi√In.) K <sub>C</sub>	K <sub>C</sub> MEAN	STAN DEV			
BUCKLING OF CRACK EDGES RESTRAINED																				
DA	Sheet	0.05	R.T.	L-T	133.6	8.000	0.050	1.020	2.100	75.20	105.00	184.26*	136.3	13.2	199.24*	---	---	1968	71709	
		0.05			133.6	8.000	0.050	1.990	3.390	52.90	79.20	145.52			206.08*			1968	71709	
		0.05			133.6	8.000	0.050	5.010	5.700	19.00	33.70	127.02			152.64*			1968	71709	
		0.05			133.6	8.000	0.050	3.500	4.790	27.00	79.90	213.08*			285.48*			1968	71709	
		0.05			133.6	8.000	0.050	1.500	3.050	62.00	87.50	137.30*			210.73*			1968	71709	
DA	Sheet	0.02	R.T.	L-T	135.5	9.000	0.020	2.110	2.630	62.20	73.30	138.16	---	---	157.35	---	1966	67821		
DA	Sheet	0.04	R.T.	L-T	132.6	9.000	0.045	2.100	2.970	45.90	66.10	124.25	---	---	163.19	---	1966	67821		
DA	Sheet	0.02	R.T.	L-T	135.5	12.000	0.020	2.020	2.360	41.60	47.90	86.85	98.4	10.0	94.49	111.7	15.0	1966	67821	
		0.02			135.5	12.000	0.020	0.950	1.240	75.00	85.00	104.24			119.42			1966	67821	
		0.02			135.5	12.000	0.020	0.580	0.700	95.00	110.20	105.34*			115.80*			1966	67821	
		0.02			135.5	12.000	0.020	2.120	2.800	42.50	55.90	104.02			121.33			1966	67821	
DA	Sheet	0.05	R.T.	L-T	133.6	20.000	0.050	2.060	5.000	62.40	85.90	155.54	158.1	11.8	250.46*	220.5	15.8	1968	71709	
		0.05			133.6	20.000	0.050	2.020	4.000	29.10	77.40	138.75			198.94			1968	71709	
		0.05			133.6	20.000	0.050	8.020	14.500	26.50	42.70	168.60			314.95*			1968	71709	
		0.05			133.6	20.000	0.050	9.940	15.000	22.80	36.40	170.65			285.62*			1968	71709	

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.

TABLE 6.21.2.2 (CONCLUDED)

Ti-8Al-1Mo-1V K <sub>C</sub>																				
CONDITION HEAT TREAT	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN		CRACK LENGTH		GROSS STRESS		K <sub>app</sub>			K <sub>C</sub>			DATE	REFER	
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	INIT (in.) 2a <sub>i</sub>	FINAL (in.) 2a <sub>f</sub>	ONSET (Ksi) σ <sub>s</sub>	MAX (Ksi) σ <sub>max</sub>	K <sub>app</sub> (Ksi/in.)	K <sub>app</sub> MEAN	STAN DEV	K <sub>C</sub> (Ksi/in.)	K <sub>C</sub> MEAN	STAN DEV			
HUCKLING OF CRACK EDGES RESTRAINED																				
DA Cont'd	Sheet Cont'd	0.05			133.6	20.000	0.060	6.040	10.000	26.80	47.60	155.45	Cont'd			224.35	Cont'd	4.9	1968	71709
		0.05			133.6	20.000	0.060	9.980	15.600	19.30	30.50	143.50				259.41*			1968	71709
		0.05	R.T. Cont'd	L-T Cont'd	133.6	20.000	0.060	6.900	11.080	36.40	45.60	160.64	Cont'd			236.94			1968	71709
		0.05			133.6	20.000	0.060	4.260	7.500	36.90	58.90	156.77				221.71			1968	71709
		0.05			133.6	20.000	0.060	3.760	7.520	49.60	69.80	173.43	Cont'd			263.23*			1968	71709
DA	Sheet	0.05			135.3	8.000	0.060	4.910	5.700	26.90	37.80	139.02	Cont'd			171.22*	Cont'd	4.9	1968	71709
		0.05			135.3	8.000	0.060	1.000	2.250	65.00	105.00	132.88*				207.62*			1968	71709
		0.05	R.T.	T-L	135.3	8.000	0.060	2.940	4.250	39.40	62.00	145.55	144.4			195.48*			1968	71709
		0.05			135.3	8.000	0.060	2.020	3.650	42.90	80.10	148.56				220.88*			1968	71709
		0.05			135.3	8.000	0.060	1.520	3.100	51.70	91.80	145.09*	Cont'd			223.65*			1968	71709

\* NOTE: NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STANDARD DEVIATION.

**This page intentionally left blank**

R | Ti-8Al-1Mo-1V |

Condition/Ht:

Form: 0.05 in. Sheet

Specimen Type: CCP (max stress specified)

Orientation: L-T

Frequency: 0.1 - 12 Hz

Environment: LAB AIR; RT

Yield Strength: 119.5 ksi

Ult. Strength: 134 ksi

Specimen Thk: 0.05 in.

Specimen Width: 6 in.

Ref: MA011

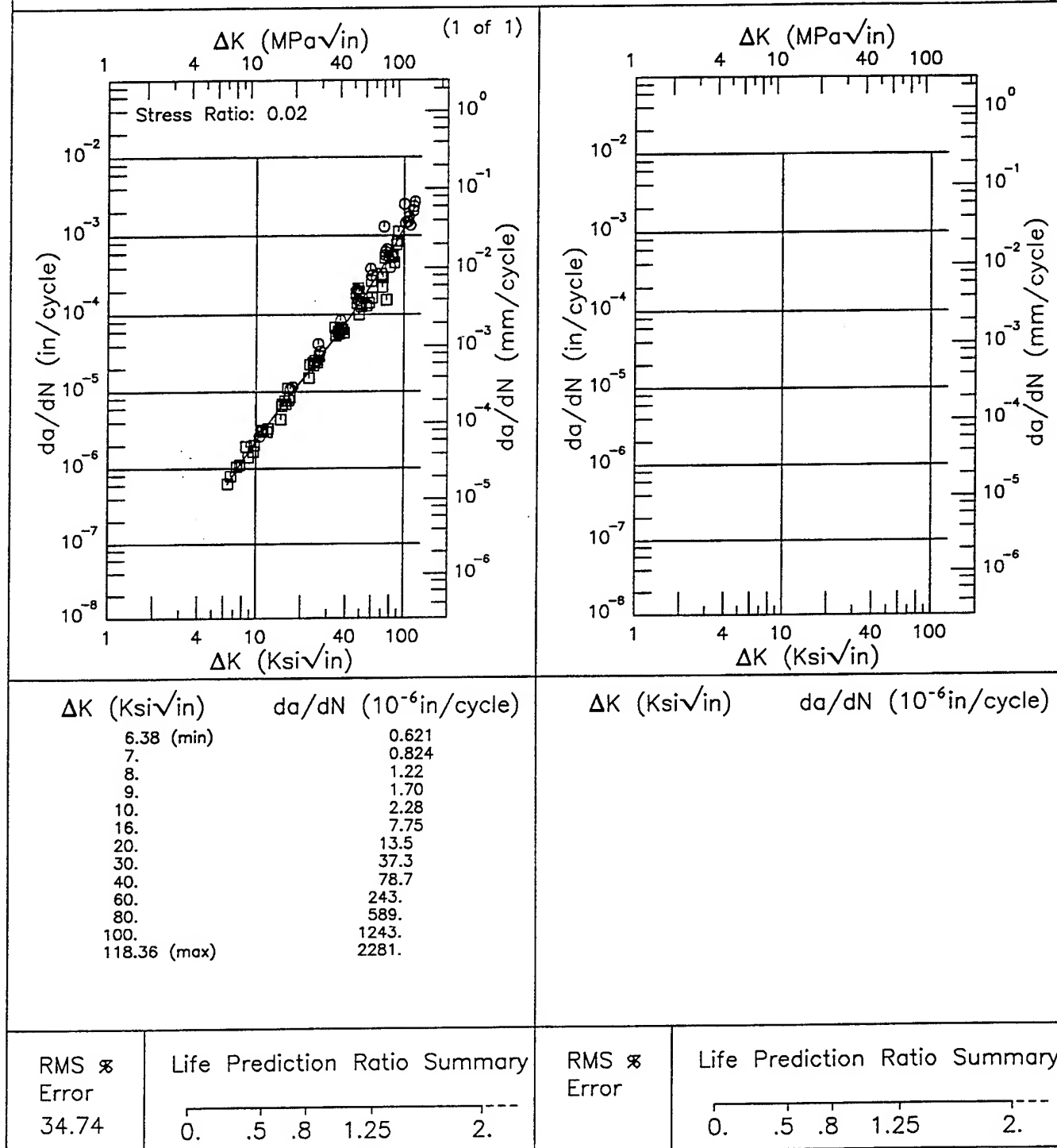
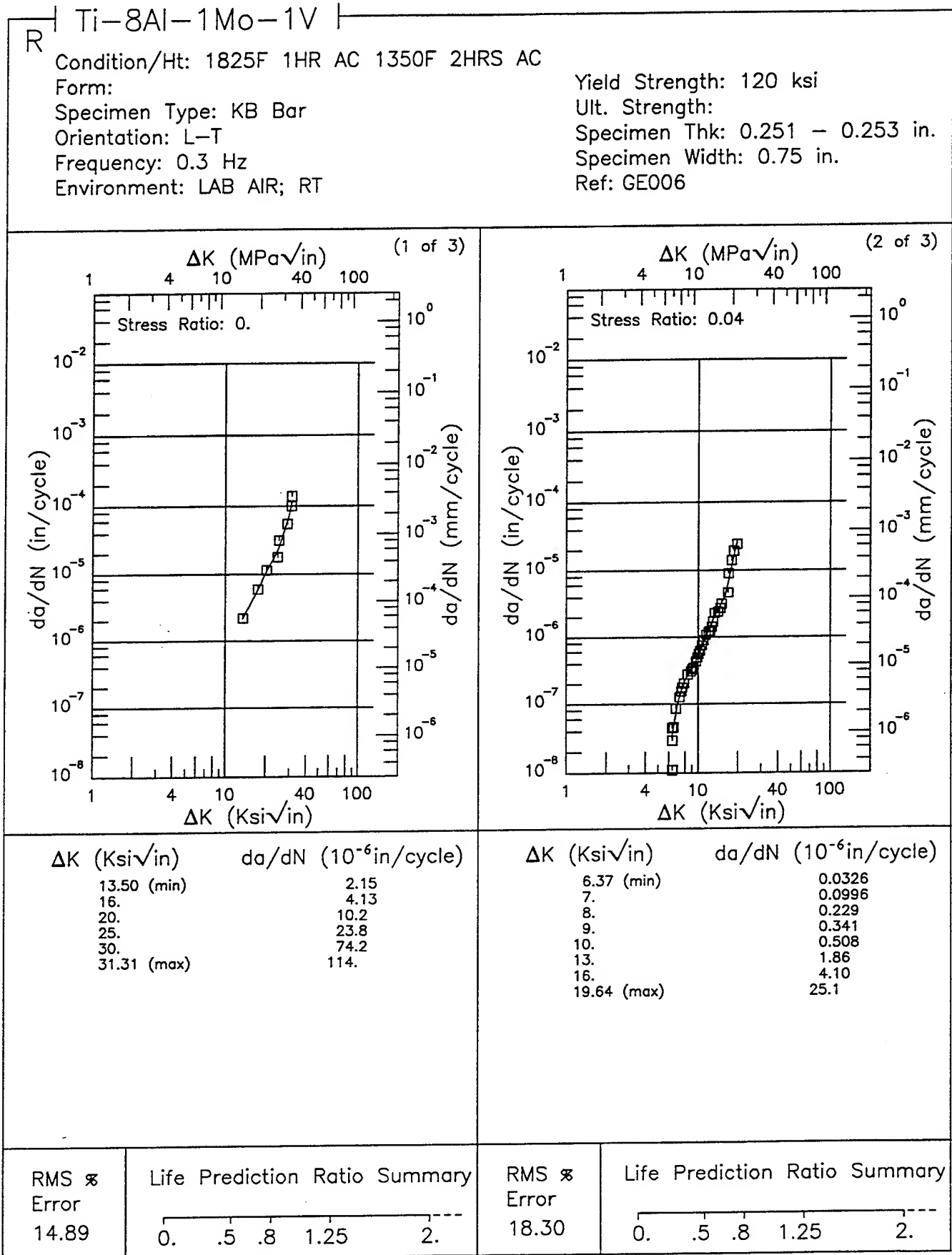


Figure 6.21.3.1.1

**This page intentionally left blank**



**Figure 6.21.3.1.2**

Condition/Ht: 1825F 1HR AC 1350F 2HRS AC  
 Form:  
 Specimen Type: KB Bar  
 Orientation: L-T  
 Frequency: 0.3 Hz  
 Environment: LAB AIR; RT

Yield Strength: 120 ksi  
 Ult. Strength:  
 Specimen Thk: 0.251 - 0.253 in.  
 Specimen Width: 0.75 in.  
 Ref: GE006

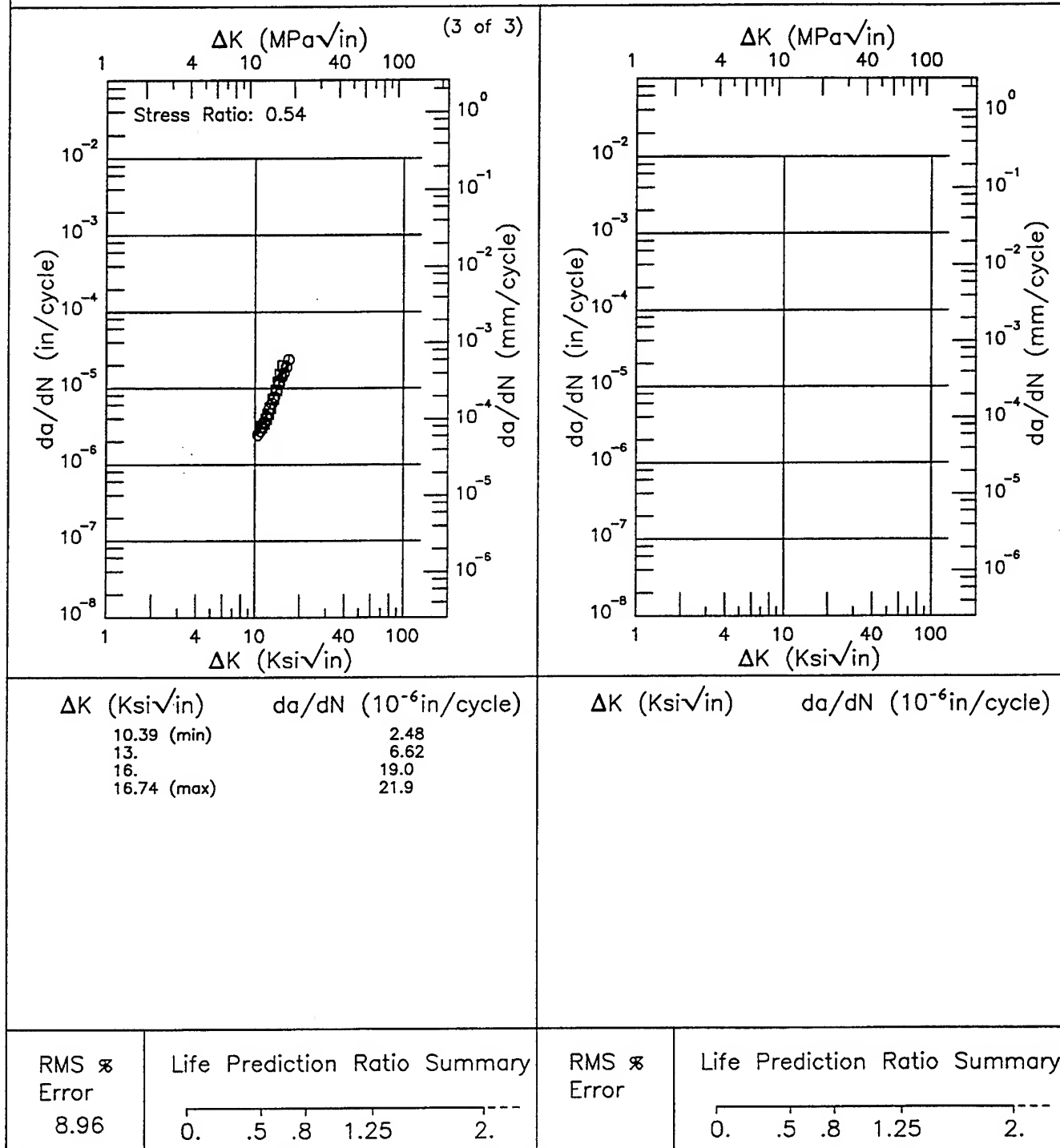
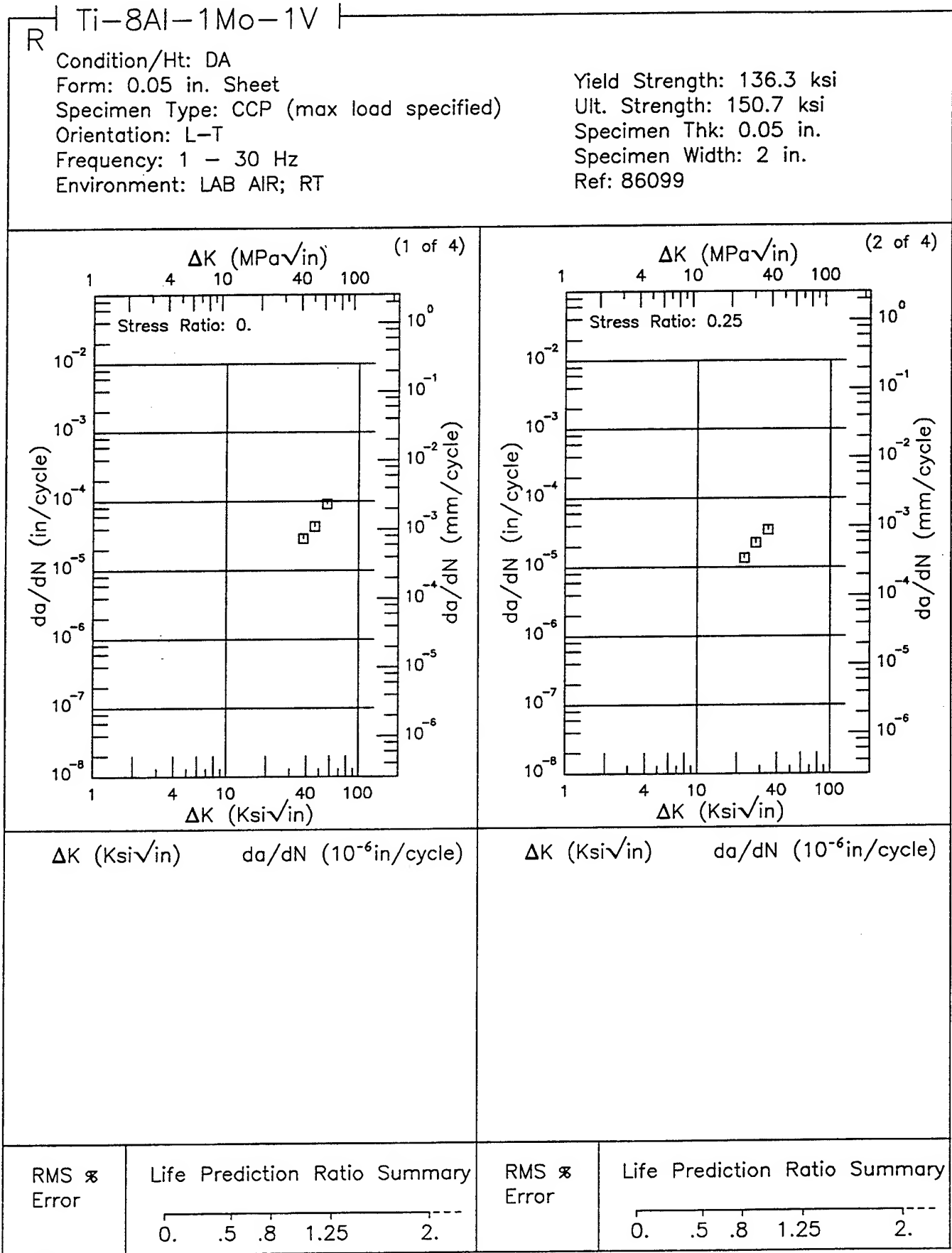


Figure 6.21.3.1.2 (Concluded)





**This page intentionally left blank**



**Figure 6.21.3.1.4**

Condition/Ht: DA  
 Form: 0.05 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Frequency: 1 - 30 Hz  
 Environment: LAB AIR; RT

Yield Strength: 136.3 ksi  
 Ult. Strength: 150.7 ksi  
 Specimen Thk: 0.05 in.  
 Specimen Width: 2 in.  
 Ref: 86099

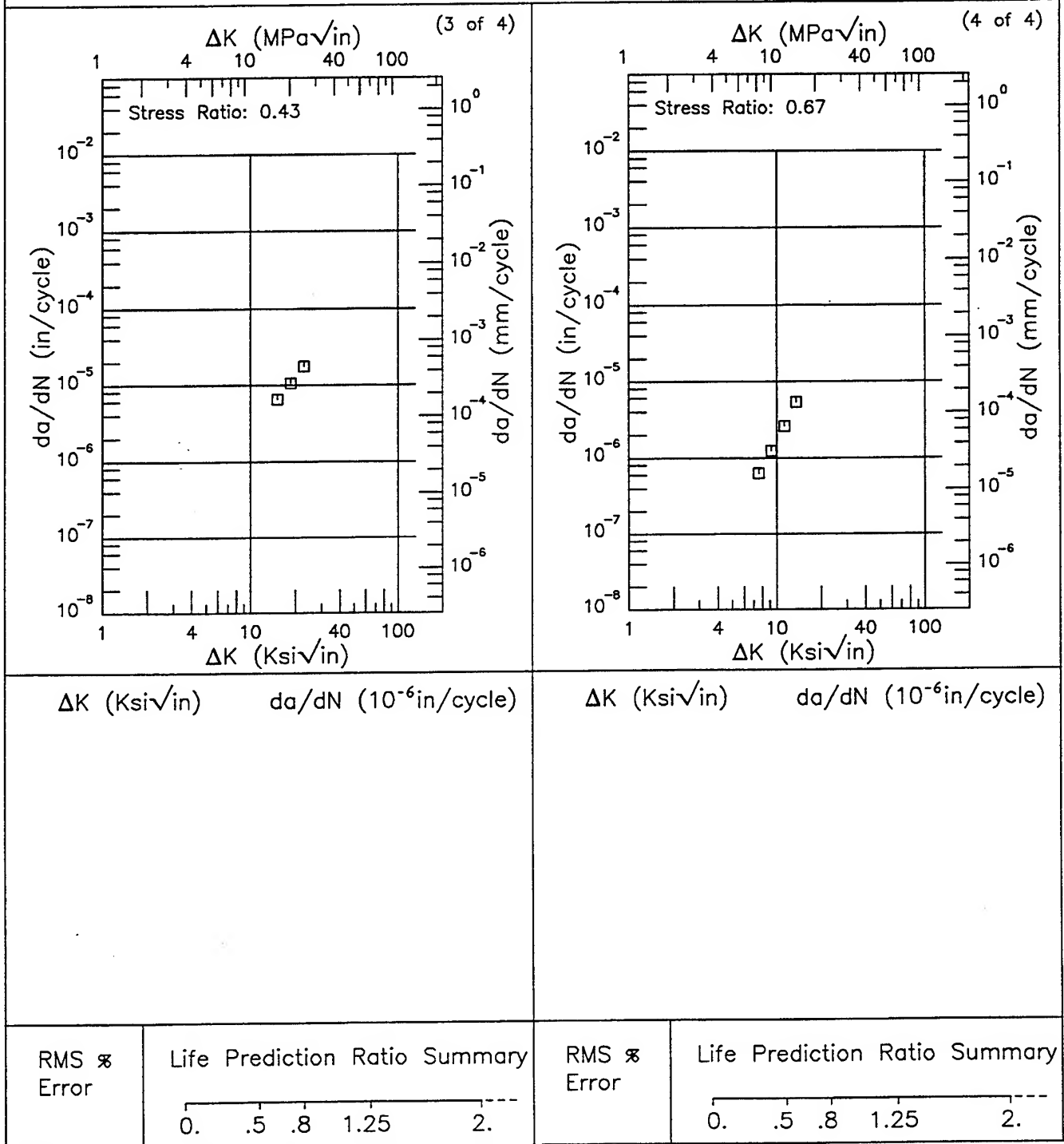


Figure 6.21.3.1.4 (Concluded)



**This page intentionally left blank**



Condition/Ht: DA  
 Form: 0.05 in. Sheet  
 Specimen Type: CCP (max load specified)  
 Orientation: L-T  
 Frequency: 1 - 30 Hz  
 Environment: LAB AIR; RT

Yield Strength: 136.3 ksi  
 Ult. Strength: 150.7 ksi  
 Specimen Thk: 0.05 in.  
 Specimen Width: 4 in.  
 Ref: 86099

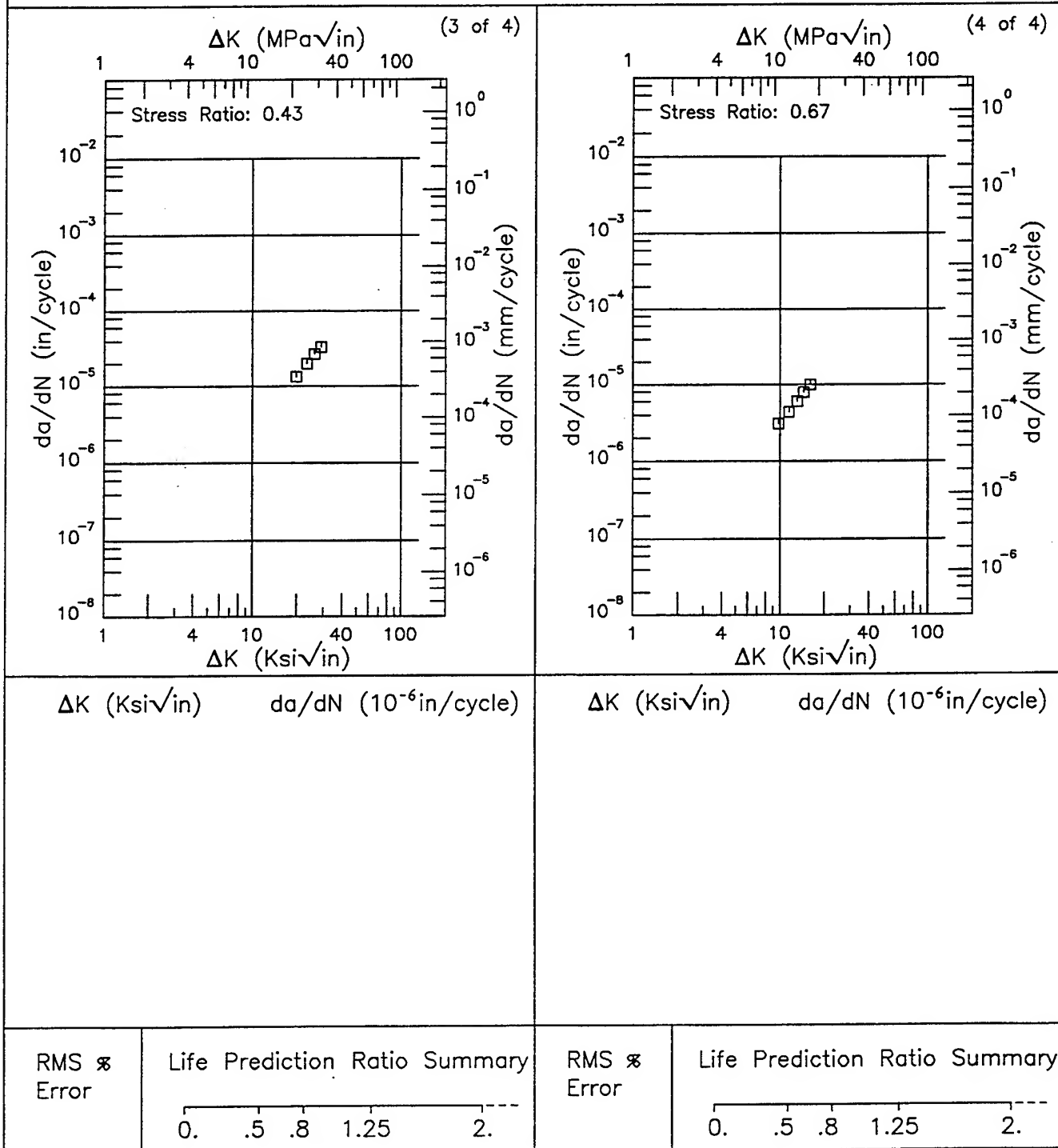


Figure 6.21.3.1.6 (Concluded)



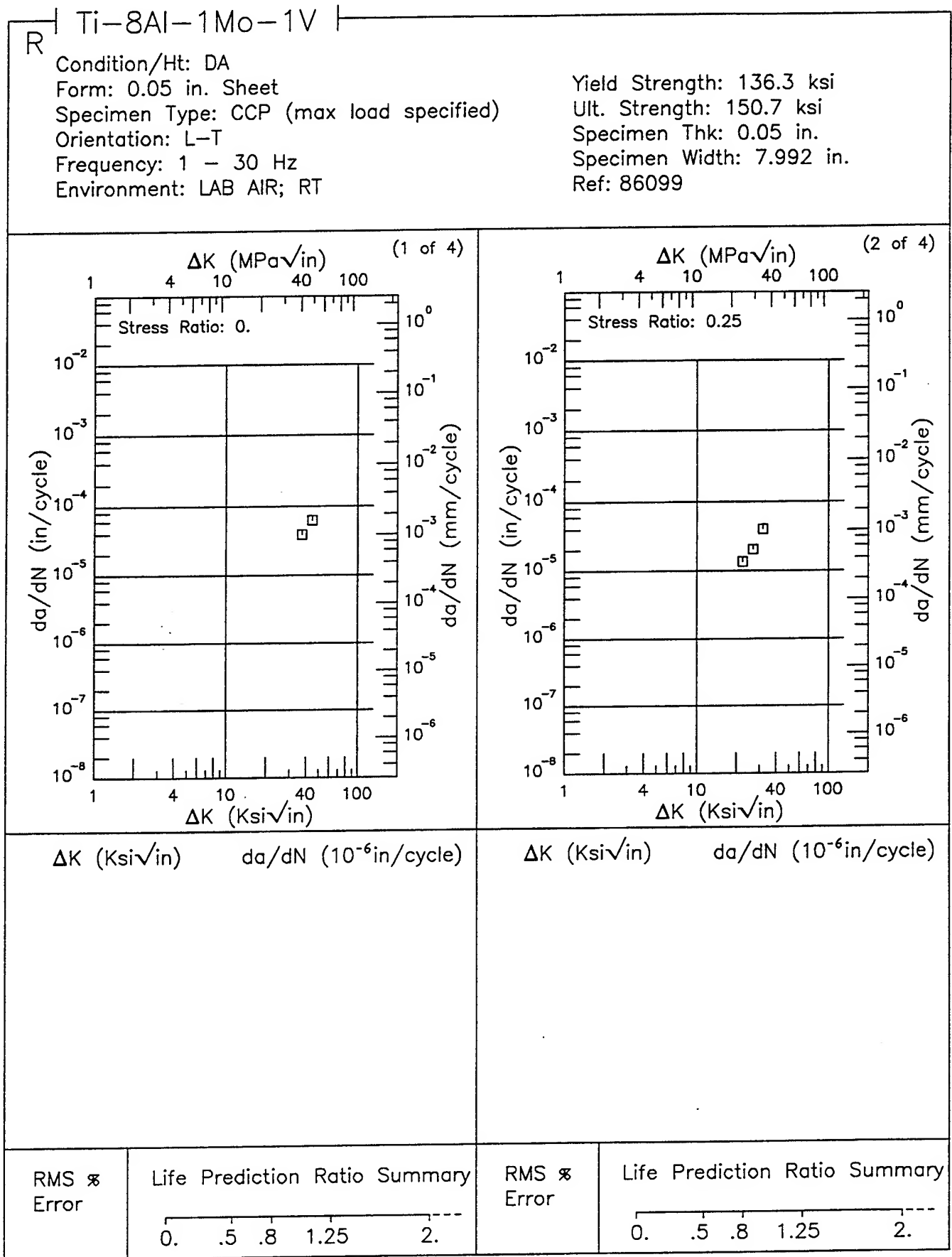


Figure 6.21.3.1.7

Condition/Ht: DA  
Form: 0.05 in. Sheet  
Specimen Type: CCP (max load specified)  
Orientation: L-T  
Frequency: 1 - 30 Hz  
Environment: LAB AIR; RT

Yield Strength: 136.3 ksi  
Ult. Strength: 150.7 ksi  
Specimen Thk: 0.05 in.  
Specimen Width: 7.992 in.  
Ref: 86099

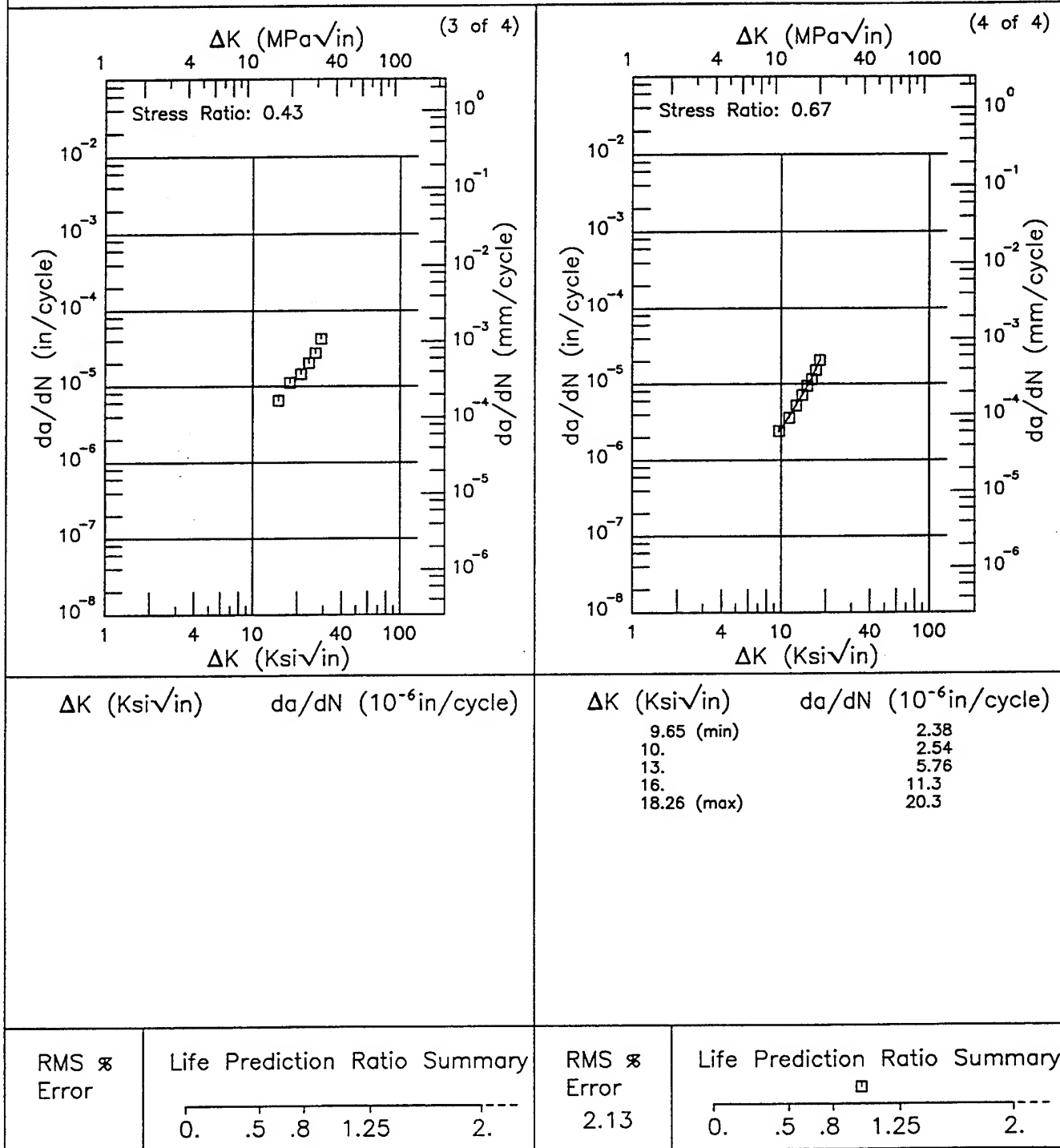


Figure 6.21.3.1.7 (Concluded)

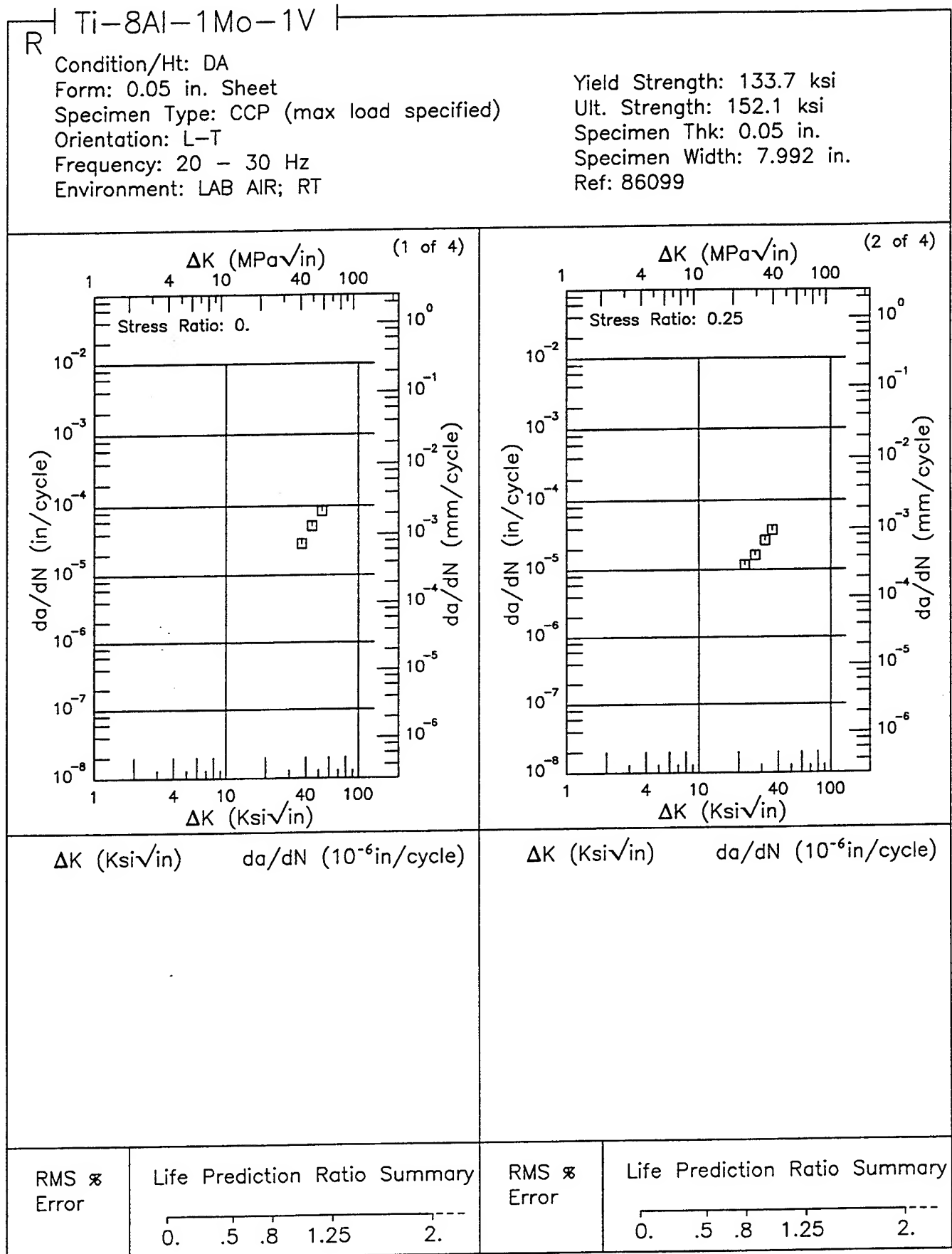


Figure 6.21.3.1.8

Ti-8Al-1Mo-1V

R

Condition/Ht: DA  
Form: 0.05 in. Sheet  
Specimen Type: CCP (max load specified)  
Orientation: L-T  
Frequency: 20 - 30 Hz  
Environment: LAB AIR; RT

Yield Strength: 133.7 ksi  
Ult. Strength: 152.1 ksi  
Specimen Thk: 0.05 in.  
Specimen Width: 7.992 in.  
Ref: 86099

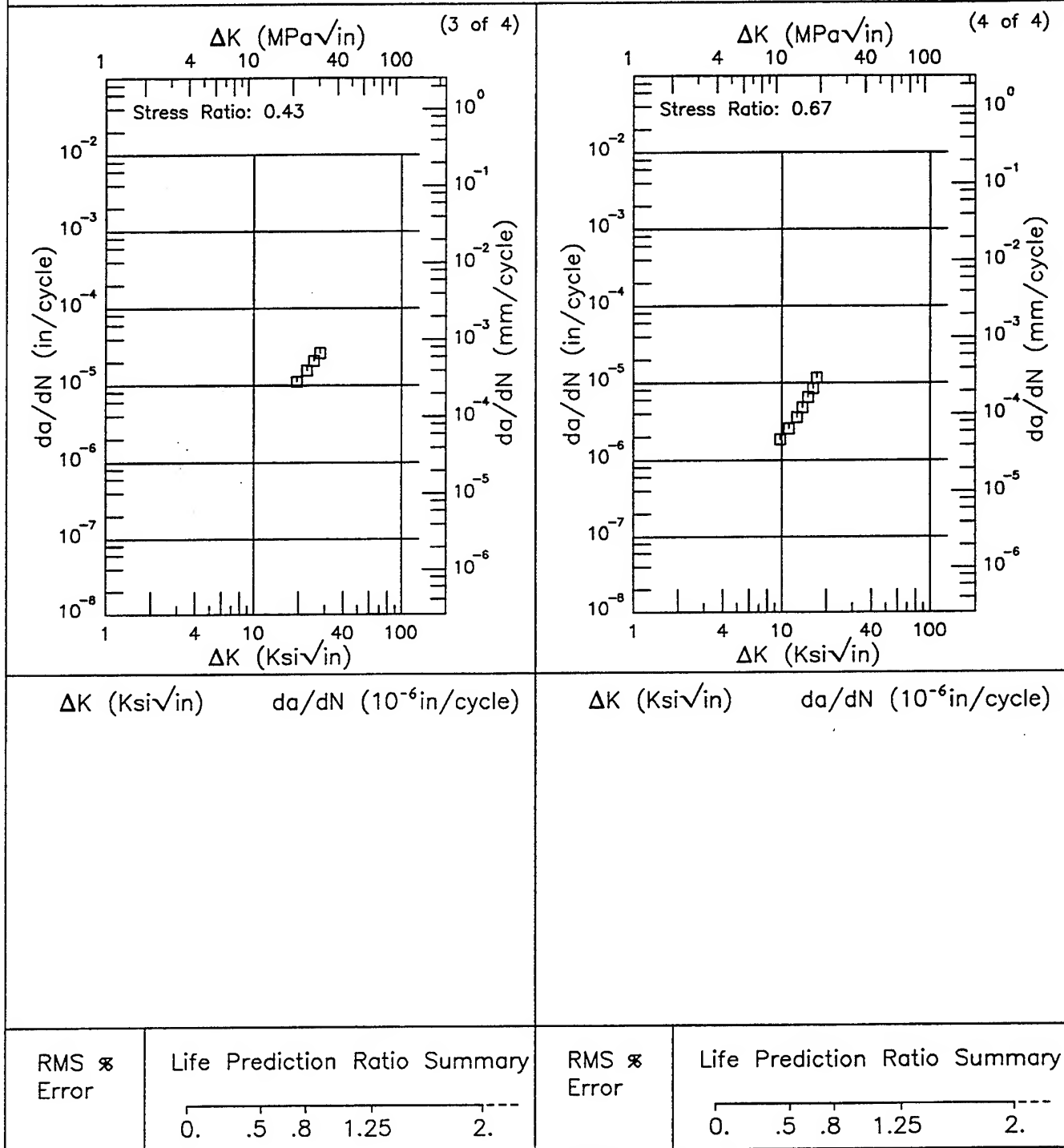


Figure 6.21.3.1.8 (Concluded)

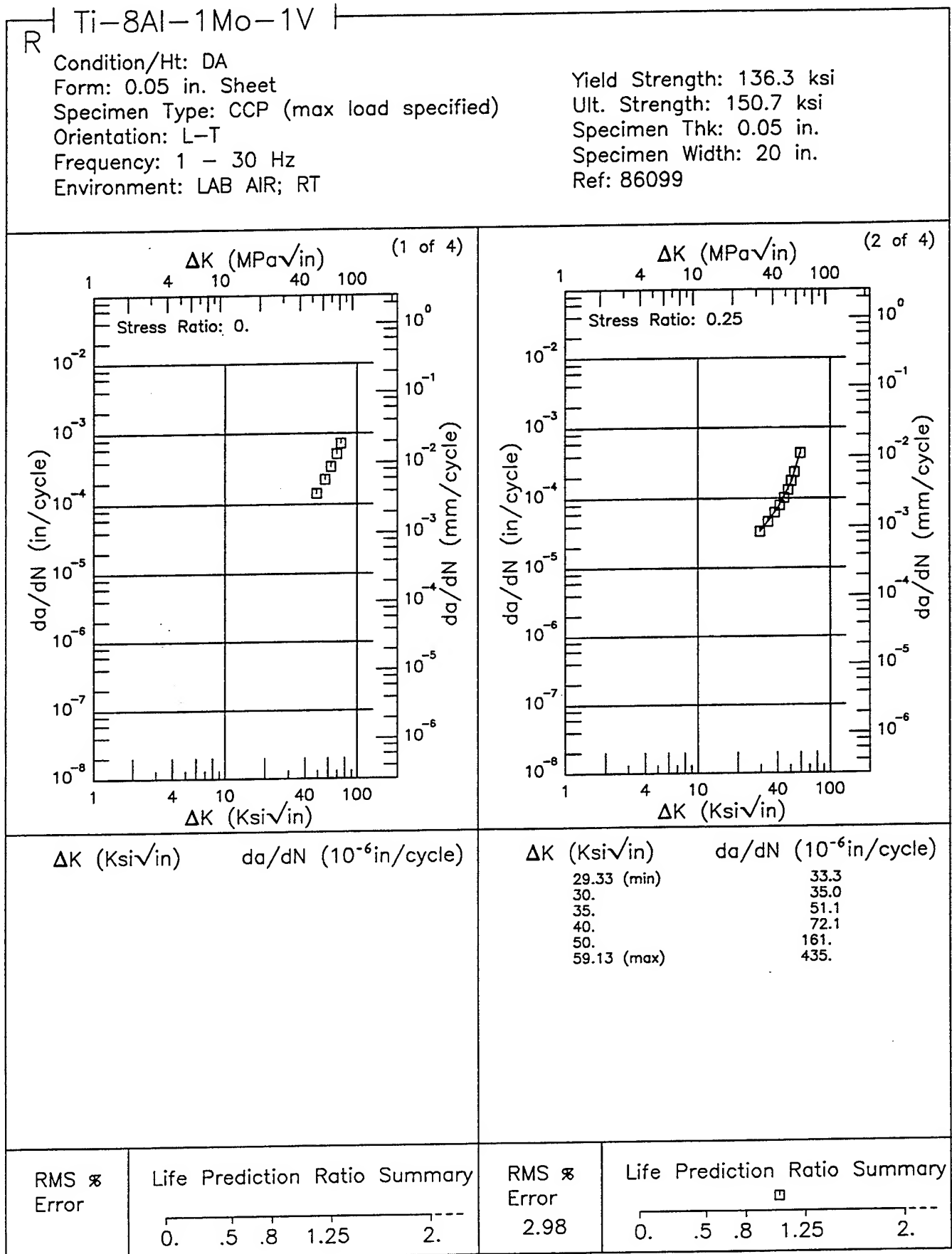


Figure 6.21.3.1.9

Condition/Ht: DA  
Form: 0.05 in. Sheet  
Specimen Type: CCP (max load specified)  
Orientation: L-T  
Frequency: 1 - 30 Hz  
Environment: LAB AIR; RT

Yield Strength: 136.3 ksi  
Ult. Strength: 150.7 ksi  
Specimen Thk: 0.05 in.  
Specimen Width: 20 in.  
Ref: 86099

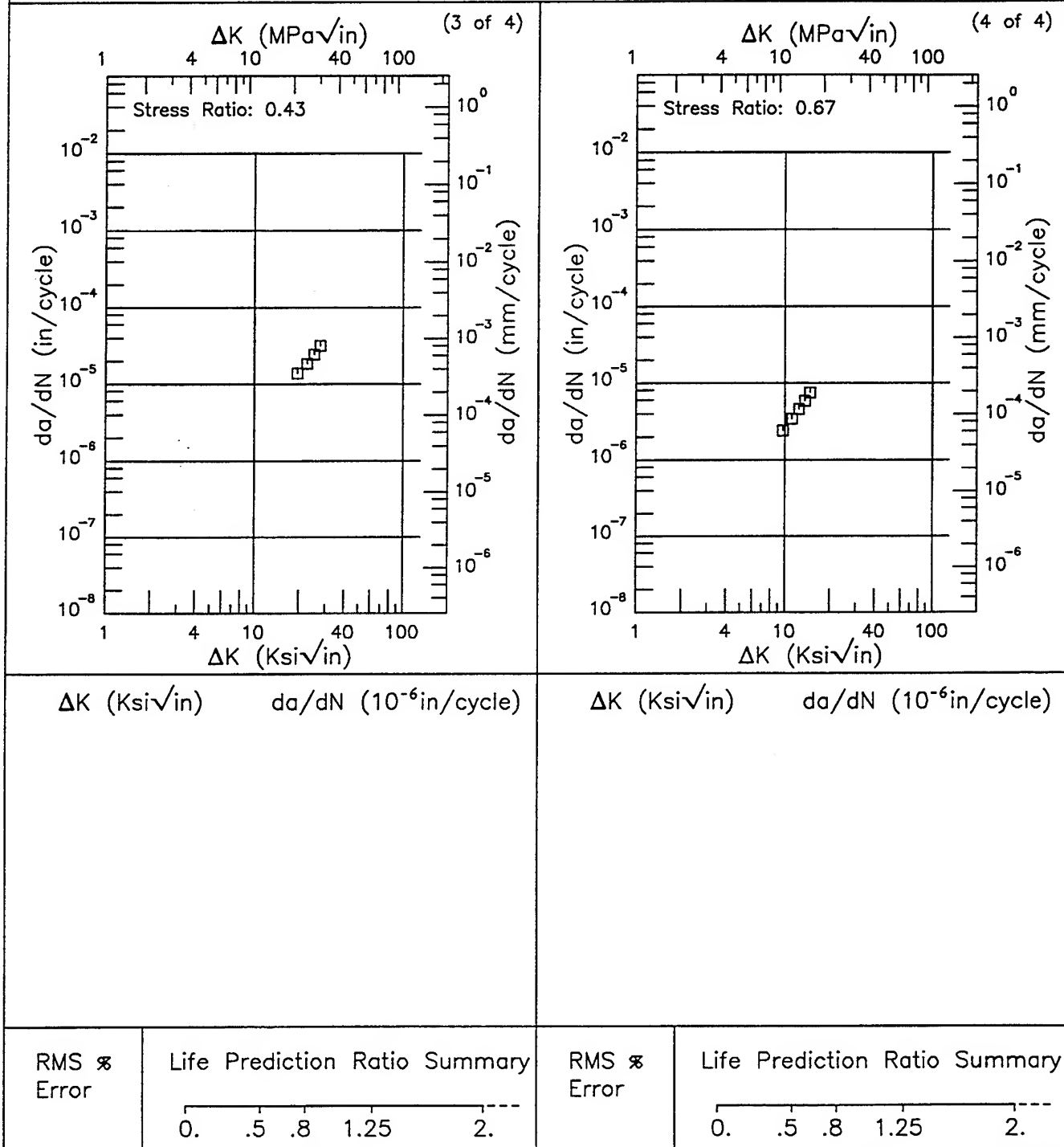


Figure 6.21.3.1.9 (Concluded)

R | Ti-8Al-1Mo-1V |

Condition/Ht: MA  
Form: 0.02 in. Sheet  
Specimen Type: CCP (max load specified)  
Orientation: L-T  
Frequency: 43 Hz  
Environment: LAB AIR; RT

Yield Strength: 154.9 ksi  
Ult. Strength: 159.2 ksi  
Specimen Thk: 0.018 in.  
Specimen Width: 3 in.  
Ref: 86099

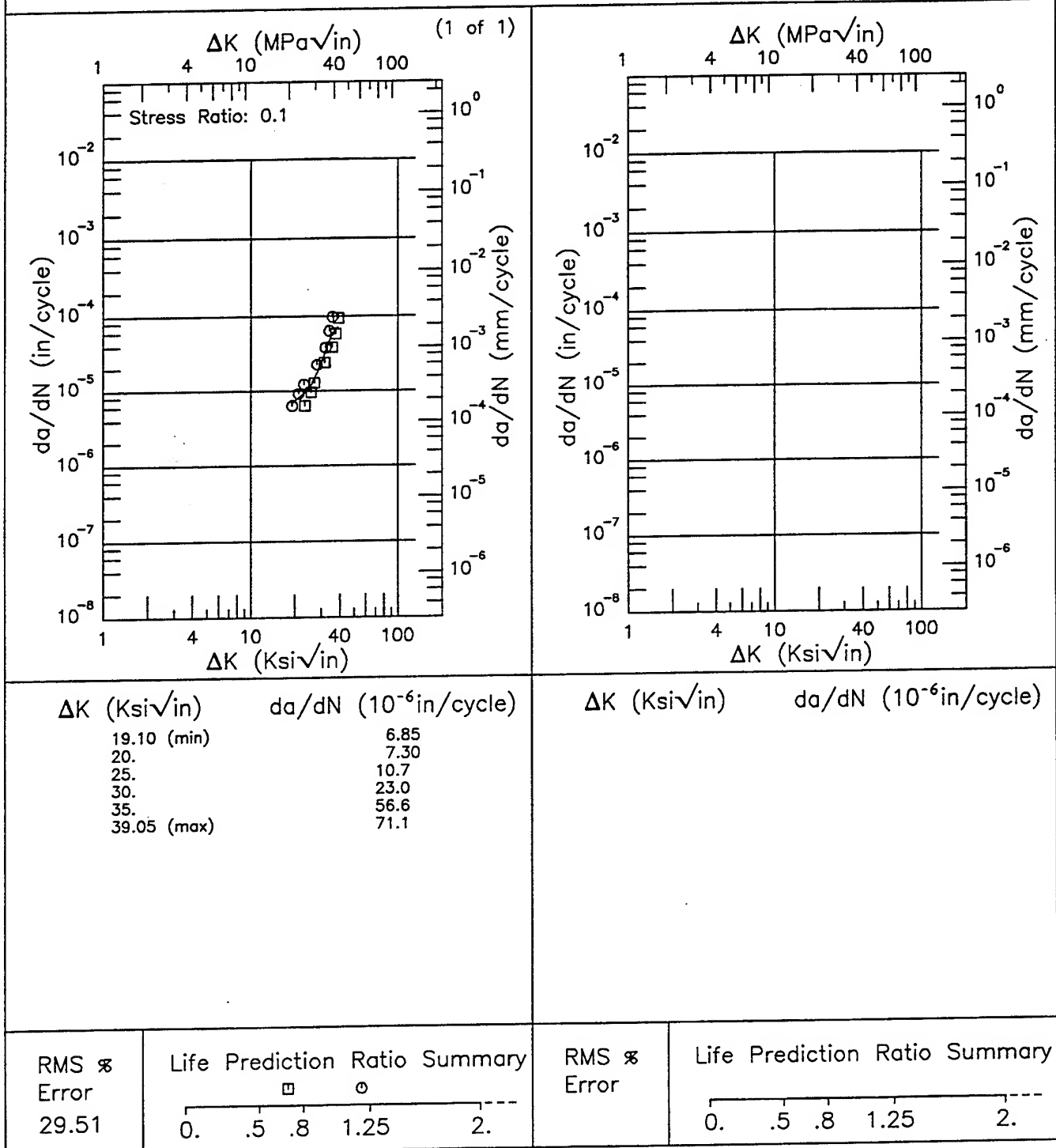


Figure 6.21.3.1.10

**This page intentionally left blank**



Ti-8Al-1Mo-1V

Condition/Ht:

Form:

Specimen Type: SENT

Orientation:

Yield Strength:

Ult. Strength:

Specimen Thk:

Specimen Width:

Ao:

K<sub>Isc</sub>:

Ref: 82651

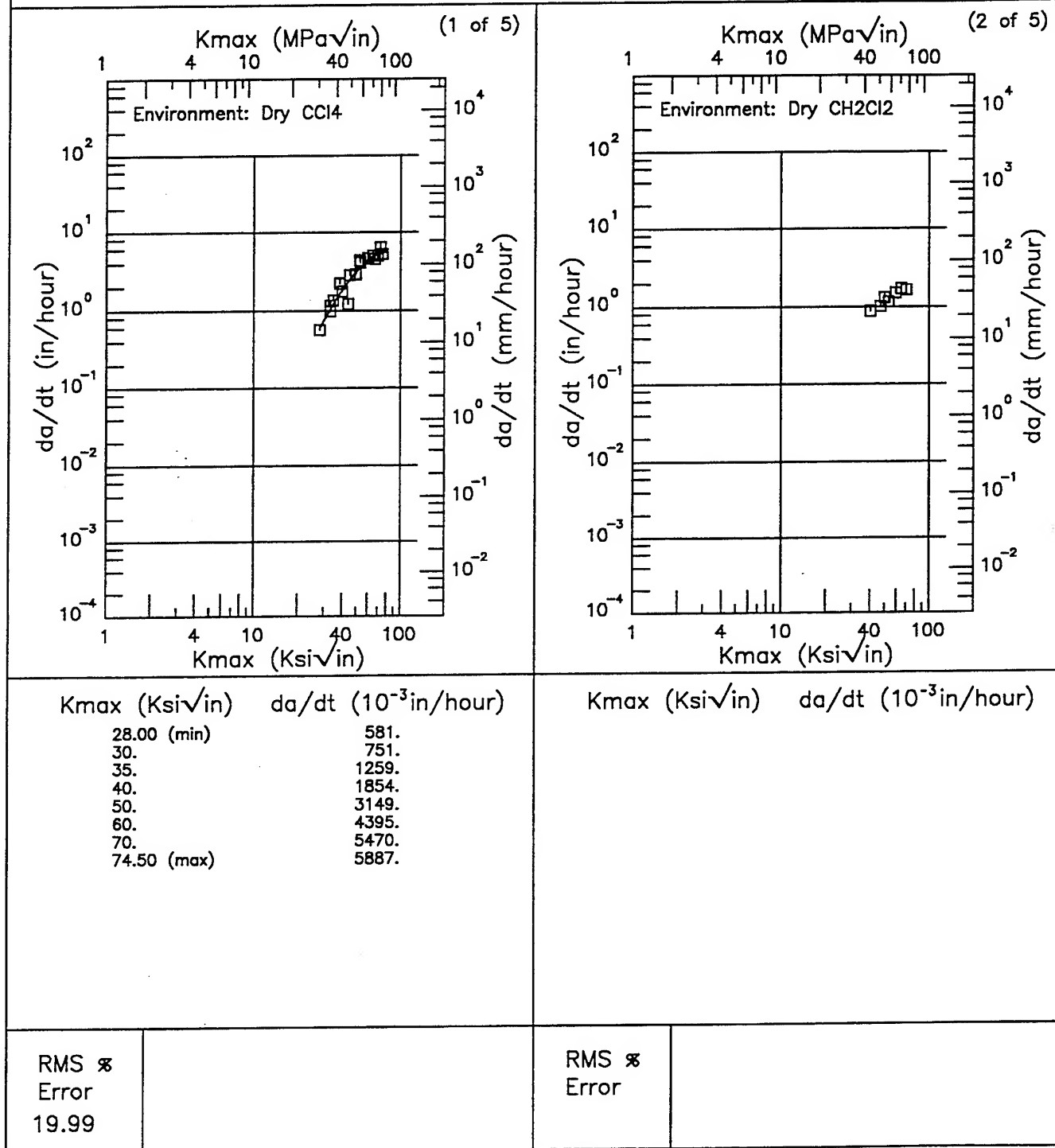


Figure 6.21.3.2.1

Condition/Ht:

Form:

Specimen Type: SENT

Orientation:

Yield Strength:

Ult. Strength:

Specimen Thk:

Specimen Width:

Ao:

K<sub>Isc</sub>:

Ref: 82651

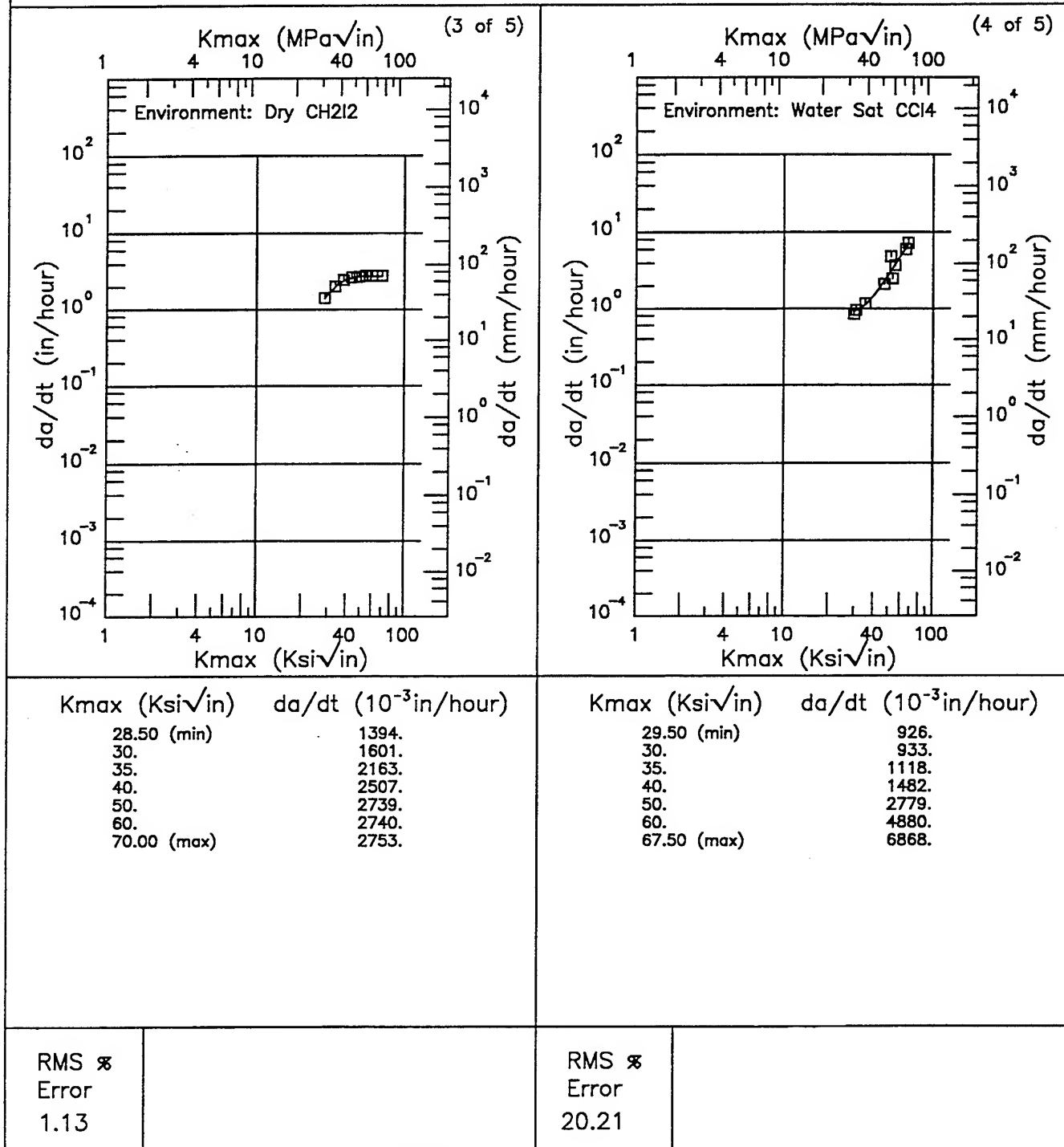


Figure 6.21.3.2.1 (Continued)

Ti-8Al-1Mo-1V

Condition/Ht:  
Form:  
Specimen Type: SENT  
Orientation:  
Yield Strength:  
Ult. Strength:

Specimen Thk:  
Specimen Width:  
Ao:  
K<sub>I</sub><sub>ISCC</sub>:  
Ref: 82651

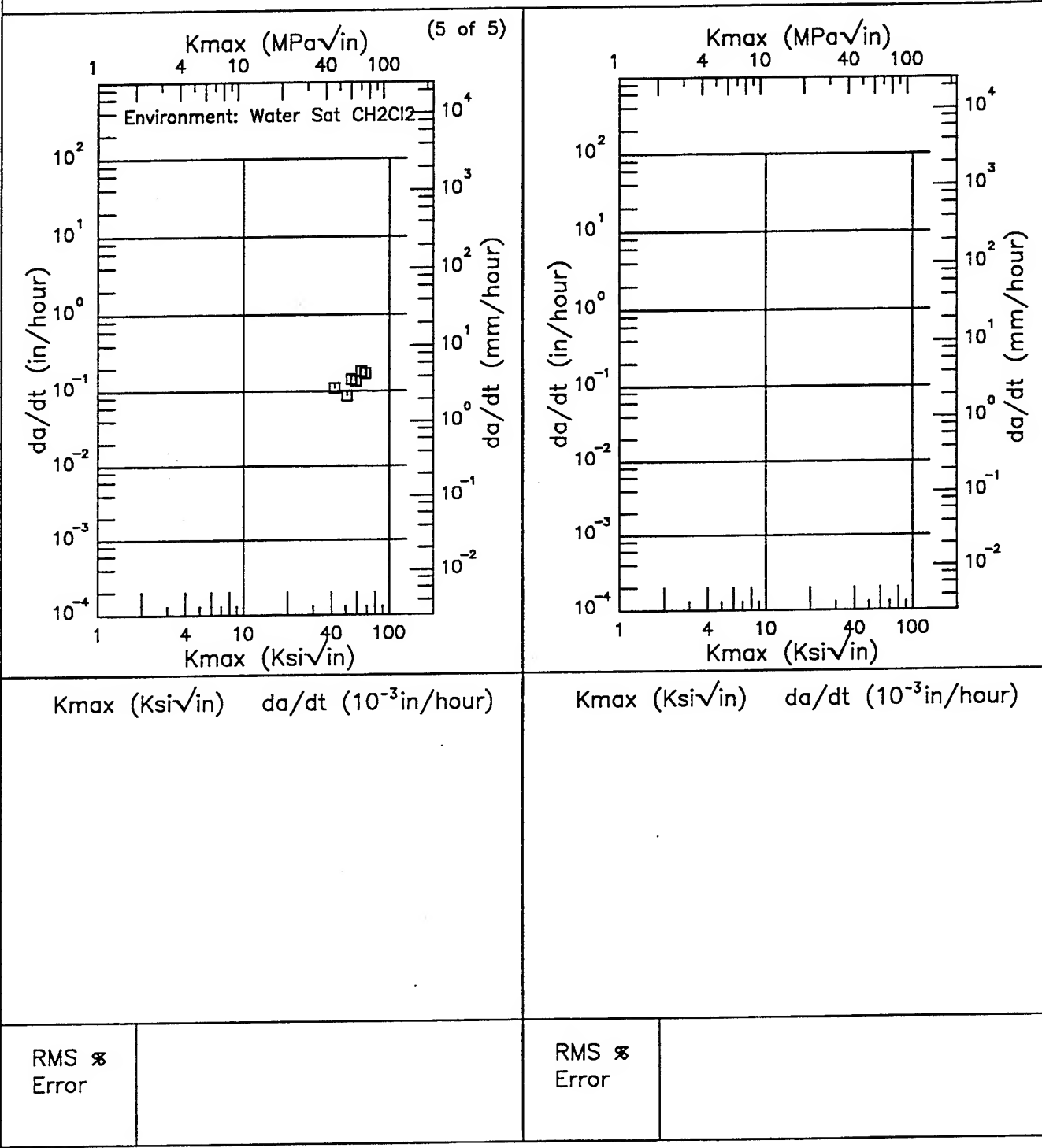


Figure 6.21.3.2.1 (Concluded)

Condition/Ht:  
Form: 0.13 in. Sheet  
Specimen Type: SENT  
Orientation:  
Yield Strength: 150 ksi  
Ult. Strength:

Specimen Thk: 0.125 in.  
Specimen Width: 3 in.  
A<sub>0</sub>:  
K<sub>Isc</sub>: 22 ksi  
Ref: 77456

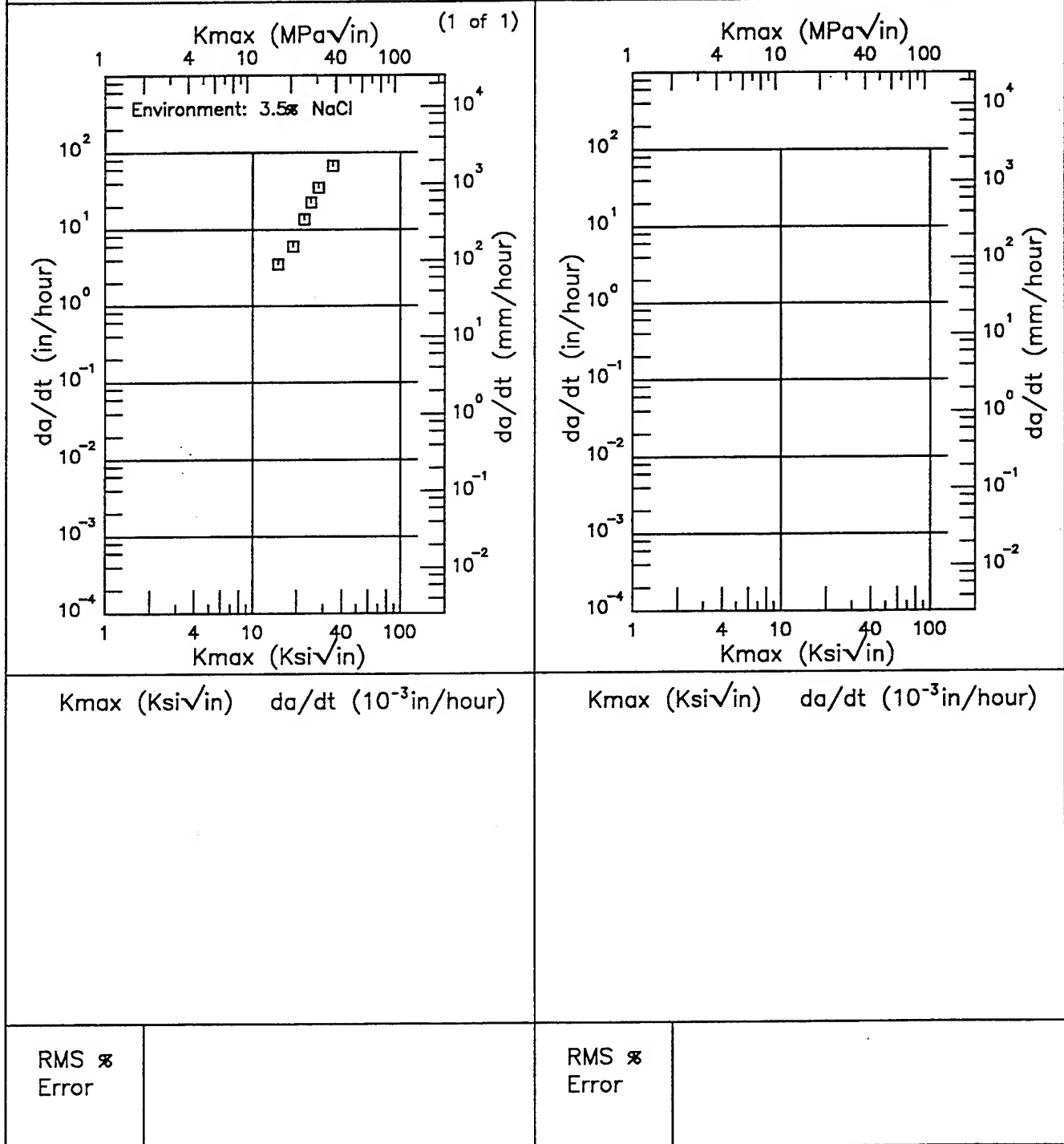
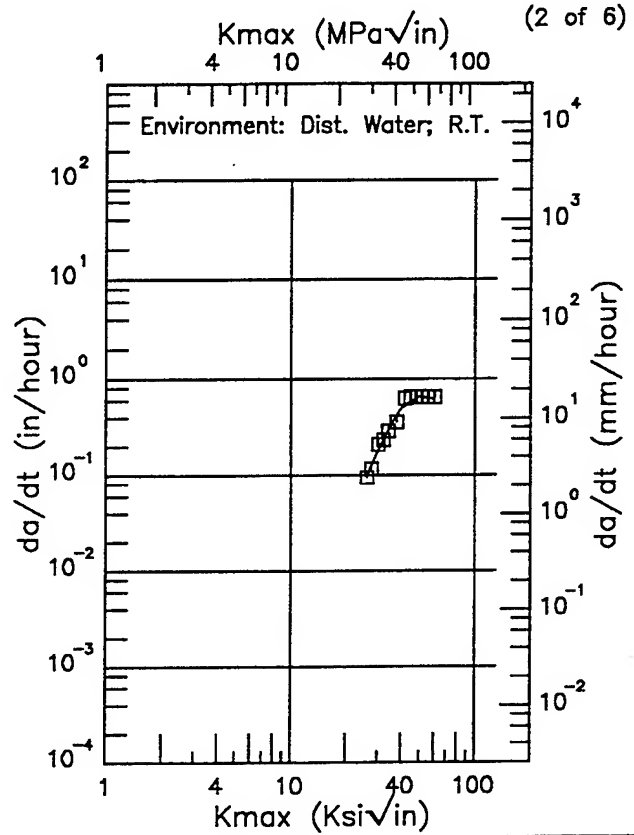
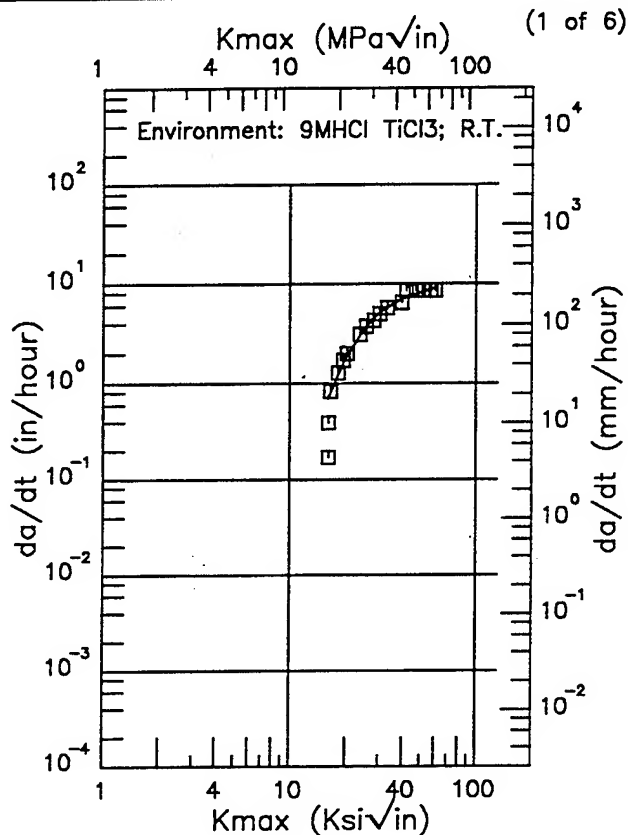


Figure 6.21.3.2.2

# Ti-8Al-1Mo-1V

Condition/Ht: 1520F 1HR WQ  
 Form: 0.25 in. Plate  
 Specimen Type: DCB  
 Orientation:  
 Yield Strength: 124 ksi  
 Ult. Strength:

Specimen Thk: 0.25 in.  
 Specimen Width:  
 A<sub>o</sub>:  
 K<sub>I</sub><sub>scc</sub>:  
 Ref: 83689



$K_{max}$ (Ksi√in)	$da/dt$ ( $10^{-3}$ in/hour)
16.00 (min)	700.
20.	1848.
25.	3569.
30.	5098.
35.	6260.
40.	7104.
50.	8238.
60.00 (max)	9154.

$K_{max}$ (Ksi√in)	$da/dt$ ( $10^{-3}$ in/hour)
26.00 (min)	96.2
30.	179.
35.	330.
40.	498.
50.	659.
60.00 (max)	626.

RMS %  
 Error  
 22.24

RMS %  
 Error  
 9.79

Figure 6.21.3.2.3

Condition/Ht: 1520F 1HR WQ  
Form: 0.25 in. Plate  
Specimen Type: DCB  
Orientation:  
Yield Strength: 124 ksi  
Ult. Strength:

Specimen Thk: 0.25 in.  
Specimen Width:  
Ao:  
K<sub>I</sub>sc:  
Ref: 83689

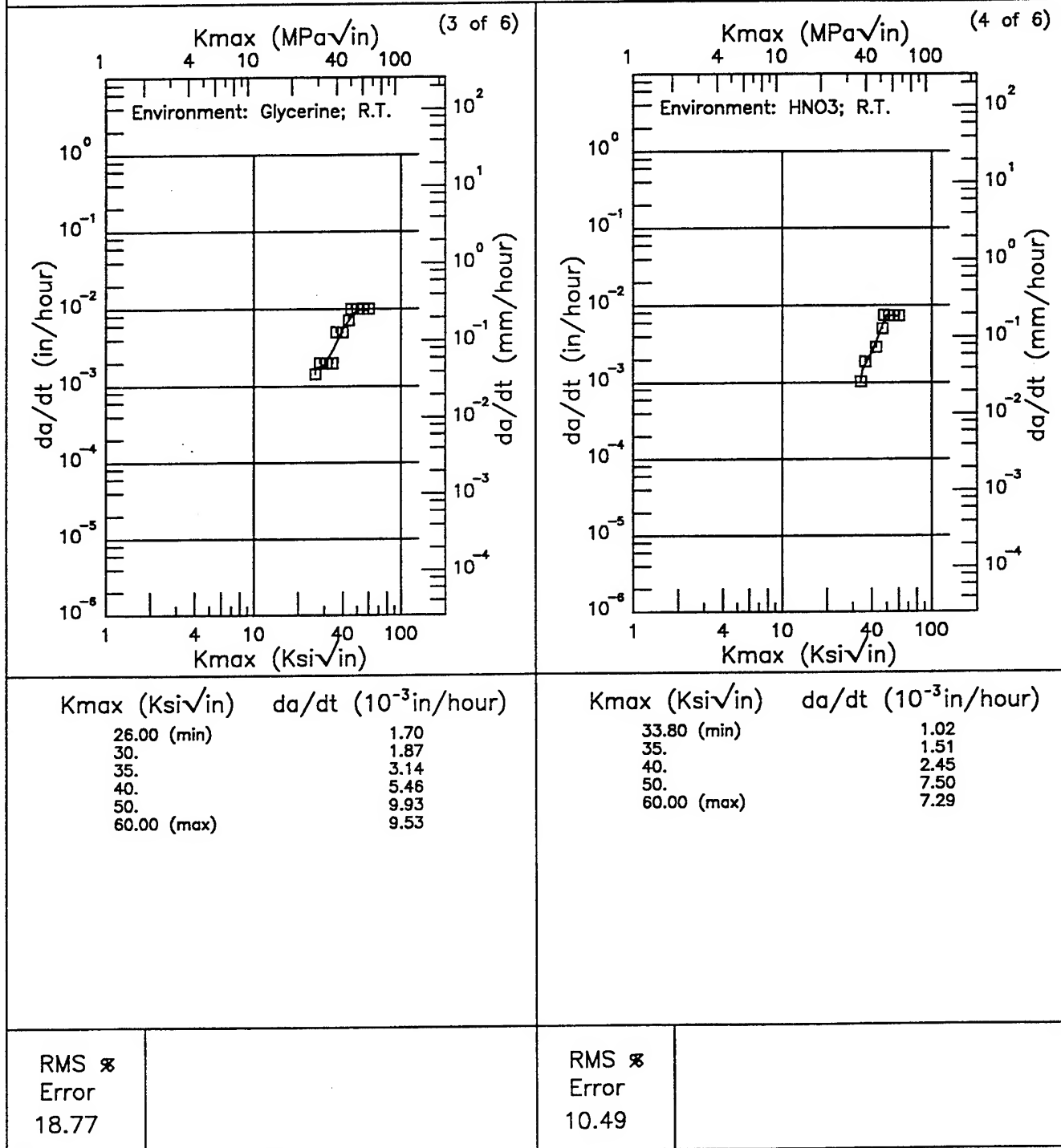
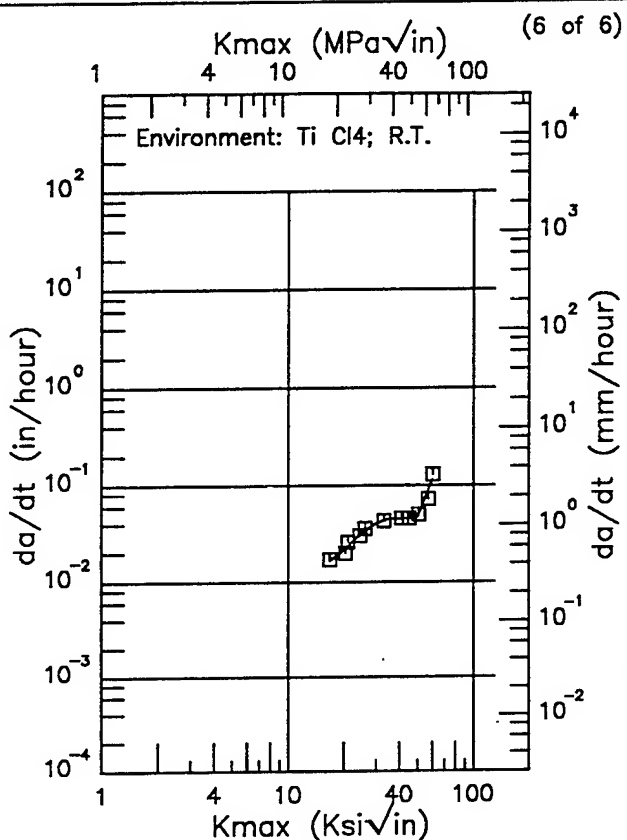
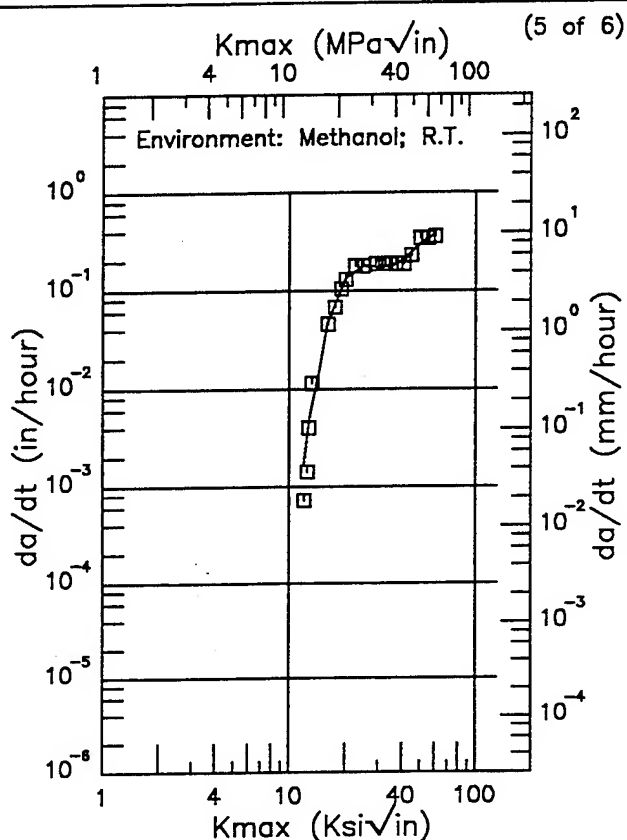


Figure 6.21.3.2.3 (Continued)

# Ti-8Al-1Mo-1V

Condition/Ht: 1520F 1HR WQ  
 Form: 0.25 in. Plate  
 Specimen Type: DCB  
 Orientation:  
 Yield Strength: 124 ksi  
 Ult. Strength:

Specimen Thk: 0.25 in.  
 Specimen Width:  
 A<sub>0</sub>:  
 K<sub>I</sub>sec:  
 Ref: 83689



Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
12.00 (min)	1.68
13.	5.53
16.	46.2
20.	135.
25.	179.
30.	175.
35.	175.
40.	201.
50.	298.
60.00 (max)	373.

Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
16.80 (min)	16.7
20.	21.5
25.	31.6
30.	40.5
35.	44.6
40.	45.4
50.	47.4
60.00 (max)	115.

RMS %  
 Error  
 26.75

RMS %  
 Error  
 8.49

Figure 6.21.3.2.3 (Concluded)

Condition/Ht: 1520F 1HR WQ

Form: 0.25 in. Plate

Specimen Type: DCB

Orientation: T-L

Yield Strength: 124 ksi

Ult. Strength:

Specimen Thk: 0.25 in.

Specimen Width: 1 in.

A<sub>0</sub>: 0.985 in.

K<sub>I</sub>sec:

Ref: 83689

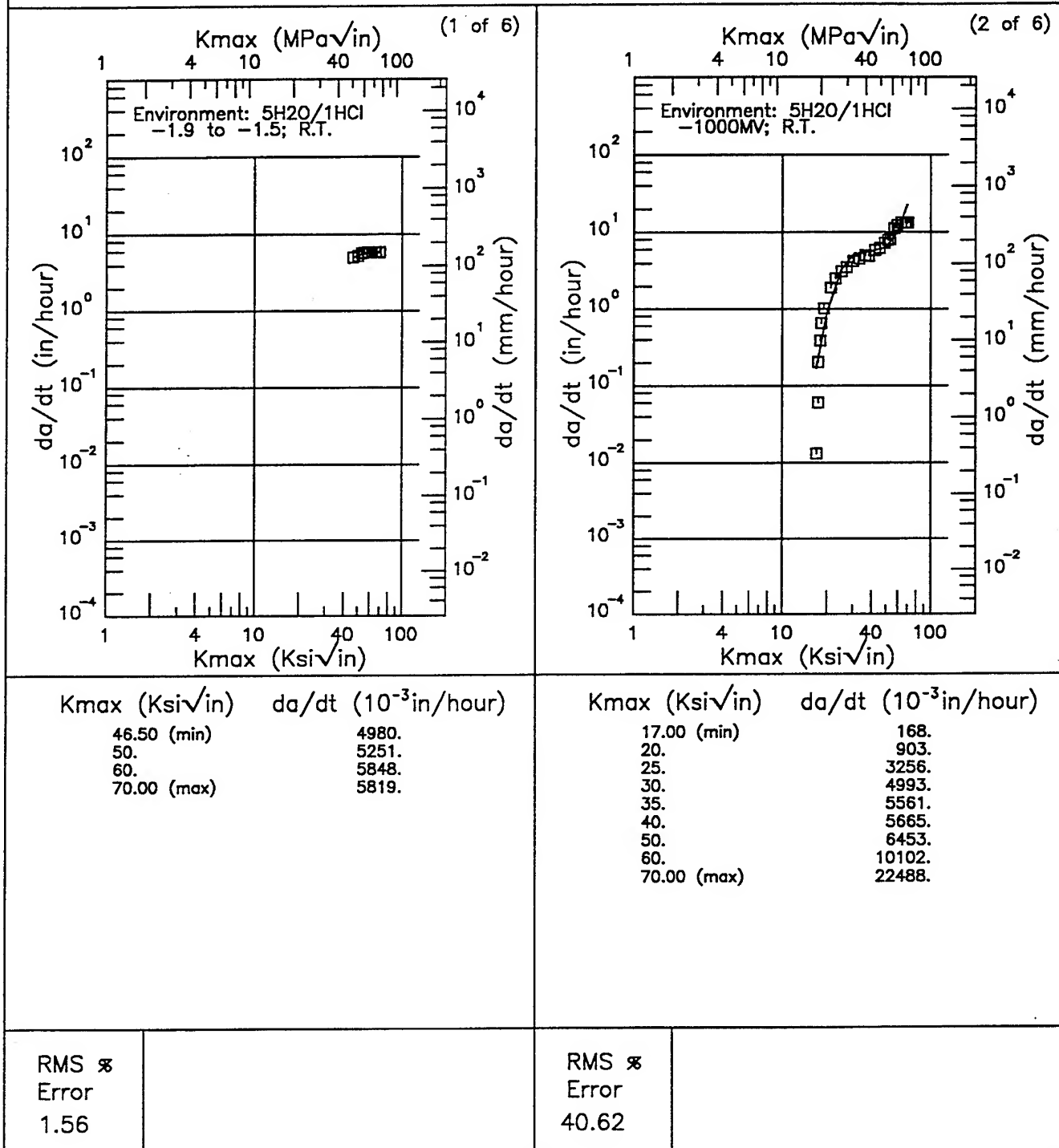


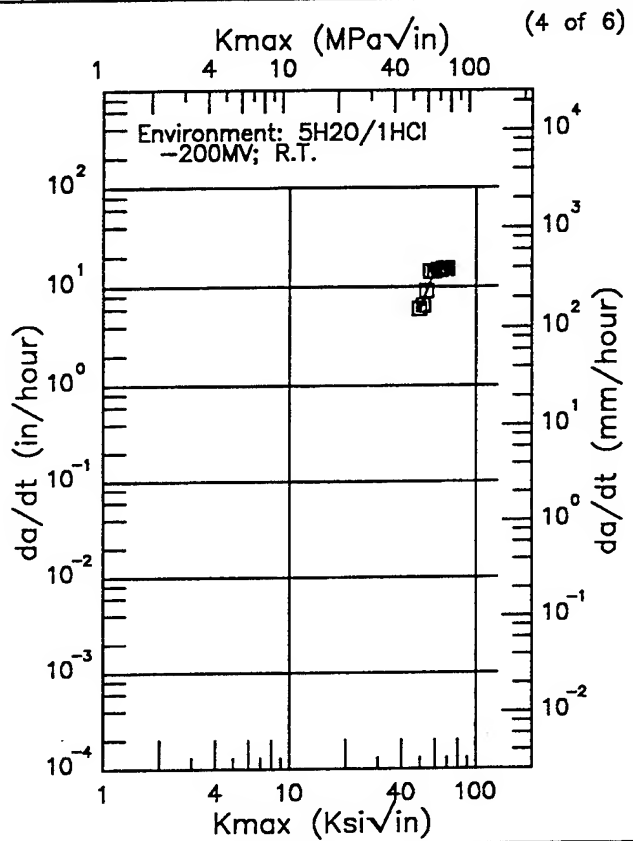
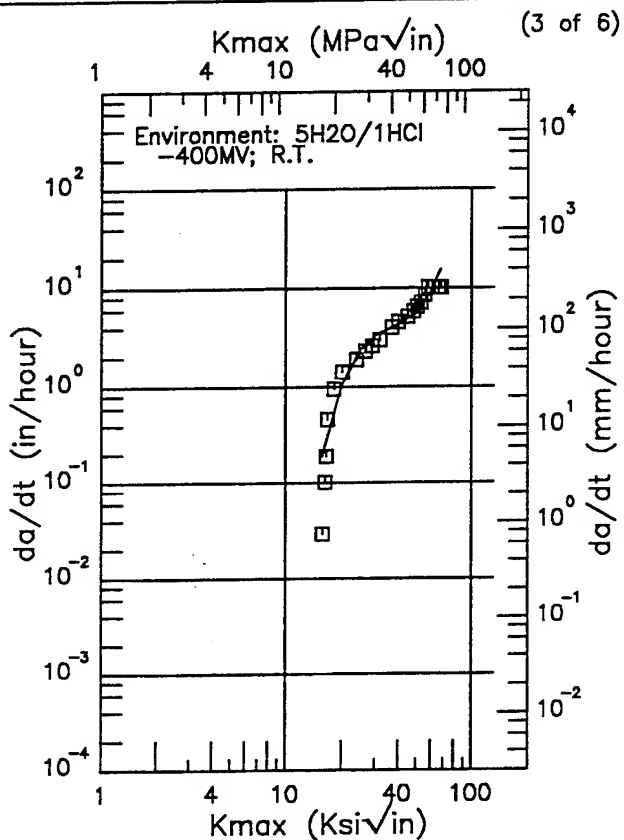
Figure 6.21.3.2.4



Ti-8Al-1Mo-1V

Condition/Ht: 1520F 1HR WQ  
 Form: 0.25 in. Plate  
 Specimen Type: DCB  
 Orientation: T-L  
 Yield Strength: 124 ksi  
 Ult. Strength:

Specimen Thk: 0.25 in.  
 Specimen Width: 1 in.  
 A<sub>0</sub>: 0.985 in.  
 K<sub>Isc</sub>:  
 Ref: 83689



Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
15.70 (min)	190.
16.	225.
20.	1047.
25.	2394.
30.	3328.
35.	3861.
40.	4278.
50.	5633.
60.	9067.
68.00 (max)	15513.

Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
49.50 (min)	5721.
50.	5869.
60.	15346.
70.00 (max)	16018.

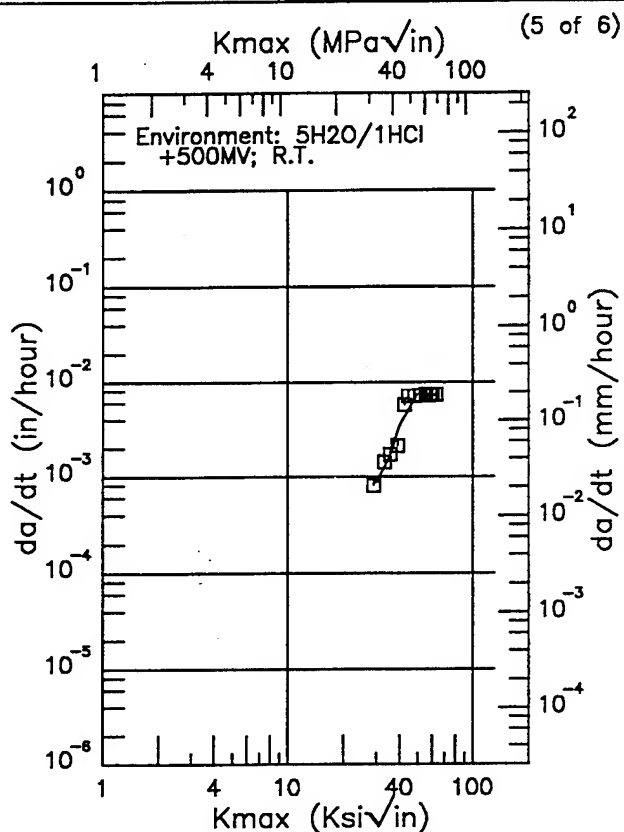
RMS %  
 Error  
 35.81

RMS %  
 Error  
 8.89

Figure 6.21.3.2.4 (Continued)

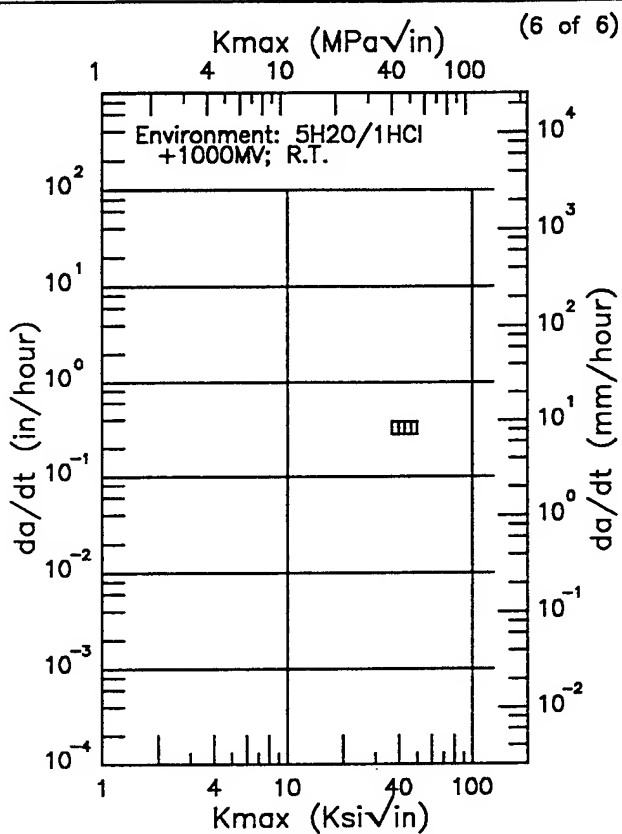
Condition/Ht: 1520F 1HR WQ  
 Form: 0.25 in. Plate  
 Specimen Type: DCB  
 Orientation: T-L  
 Yield Strength: 124 ksi  
 Ult. Strength:

Specimen Thk: 0.25 in.  
 Specimen Width: 1 in.  
 A<sub>0</sub>: 0.985 in.  
 K<sub>Isc</sub>:  
 Ref: 83689



Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
29.00 (min)	0.850
30.	0.871
35.	1.57
40.	3.46
50.	7.48
60.	7.20
63.00 (max)	7.30

RMS %  
 Error  
 17.47



Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
---------------	----------------------------------

RMS %  
 Error

Figure 6.21.3.2.4 (Concluded)

Ti-8Al-1Mo-1V

Condition/Ht: 1725F FC 1200F 3HR WQ

Form: 0.25 in. Plate

Specimen Type: CB

Orientation: T-L

Yield Strength:

Ult. Strength:

Specimen Thk: 0.25 in.

Specimen Width: 2 in.

A<sub>0</sub>: 0.25 in.

K<sub>Isc</sub>:

Ref: 85855

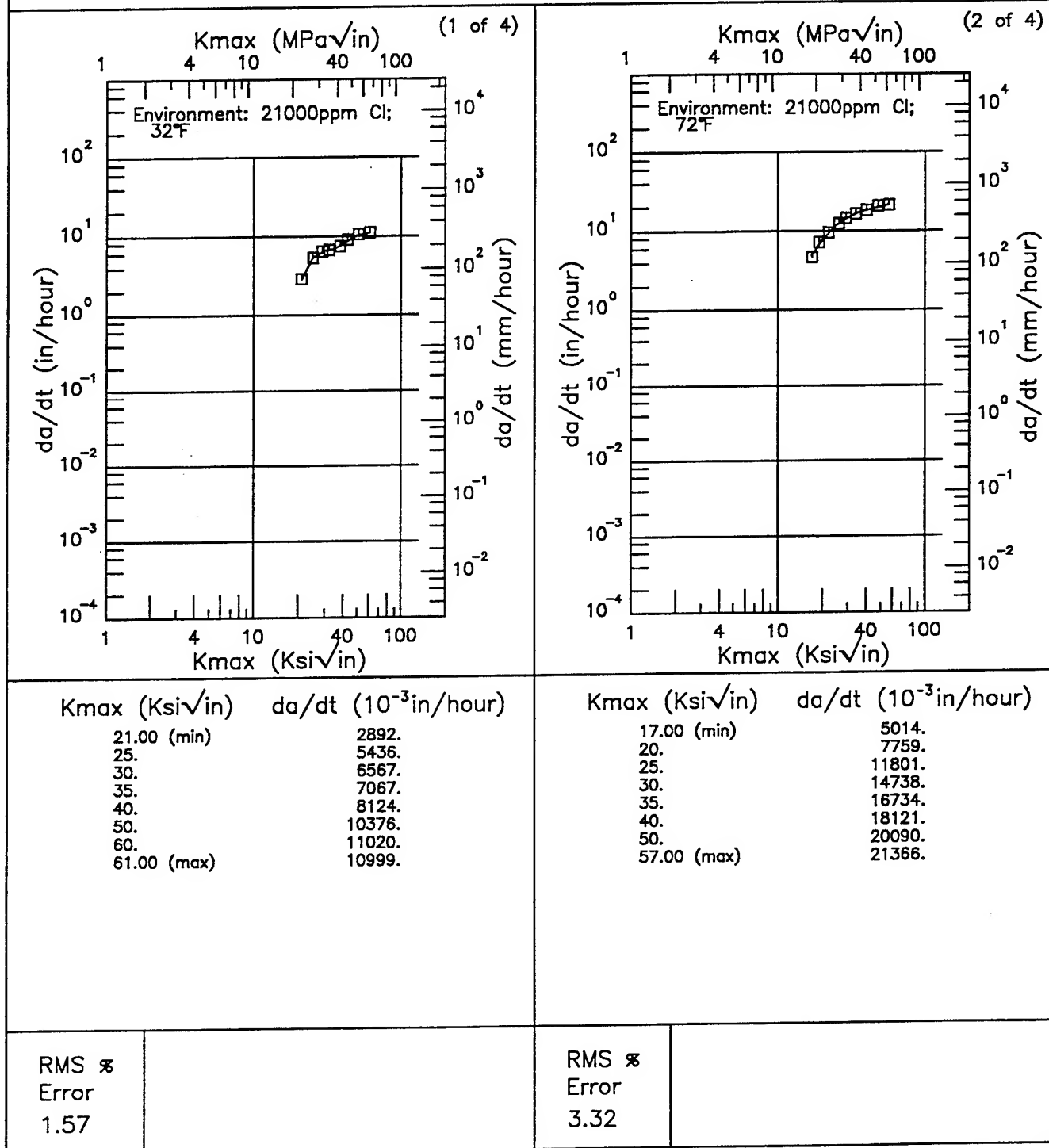
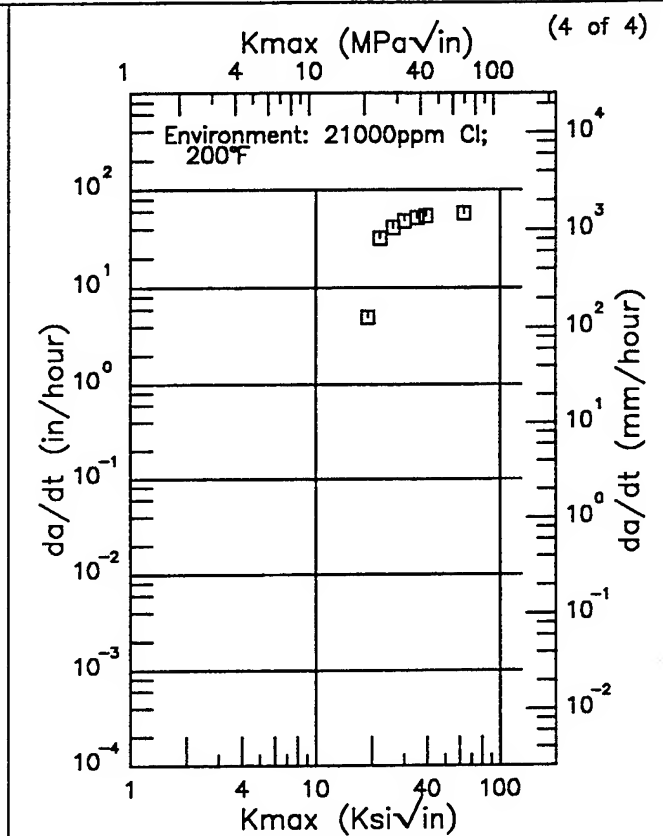
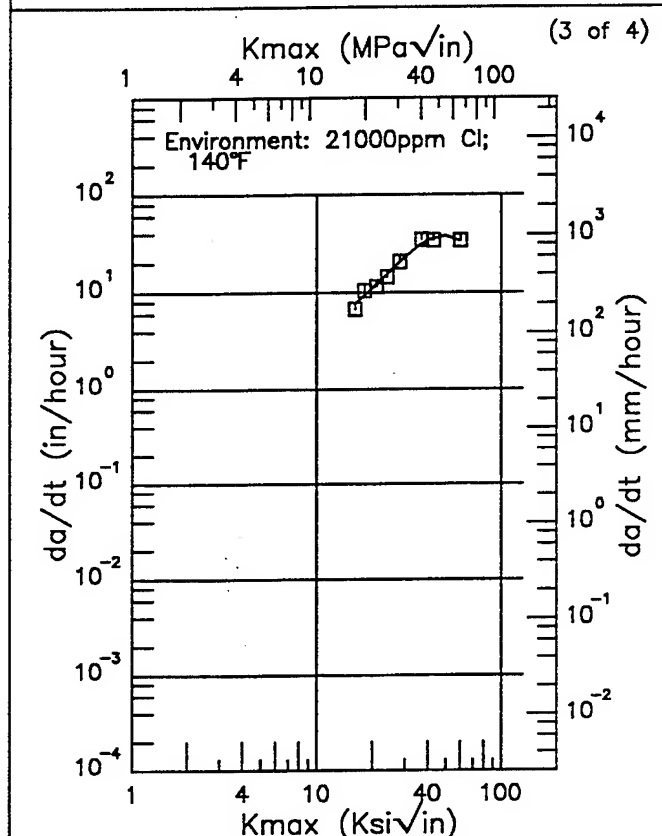


Figure 6.21.3.2.5

Condition/Ht: 1725F FC 1200F 3HR WQ  
 Form: 0.25 in. Plate  
 Specimen Type: CB  
 Orientation: T-L  
 Yield Strength:  
 Ult. Strength:

Specimen Thk: 0.25 in.  
 Specimen Width: 2 in.  
 A<sub>0</sub>: 0.25 in.  
 K<sub>Isc</sub>:  
 Ref: 85855



Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
16.00 (min)	7709.
20.	10915.
25.	16530.
30.	23037.
35.	29281.
40.	34200.
50.	37827.
60.00 (max)	33748.

Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
16.00 (min)	7709.
20.	10915.
25.	16530.
30.	23037.
35.	29281.
40.	34200.
50.	37827.
60.00 (max)	33748.

RMS % Error	7.58
-------------	------

RMS % Error	
-------------	--

Figure 6.21.3.2.5 (Concluded)

Ti-8Al-1Mo-1V

Condition/Ht: 1725F FC 1200F 3HR WQ  
 Form: 0.25 in. Plate  
 Specimen Type: CB  
 Orientation: T-L  
 Yield Strength: 150 ksi  
 Ult. Strength:

Specimen Thk: 0.25 in.  
 Specimen Width: 2 in.  
 A<sub>0</sub>: 0.25 in.  
 K<sub>Isc</sub>:  
 Ref: 85855

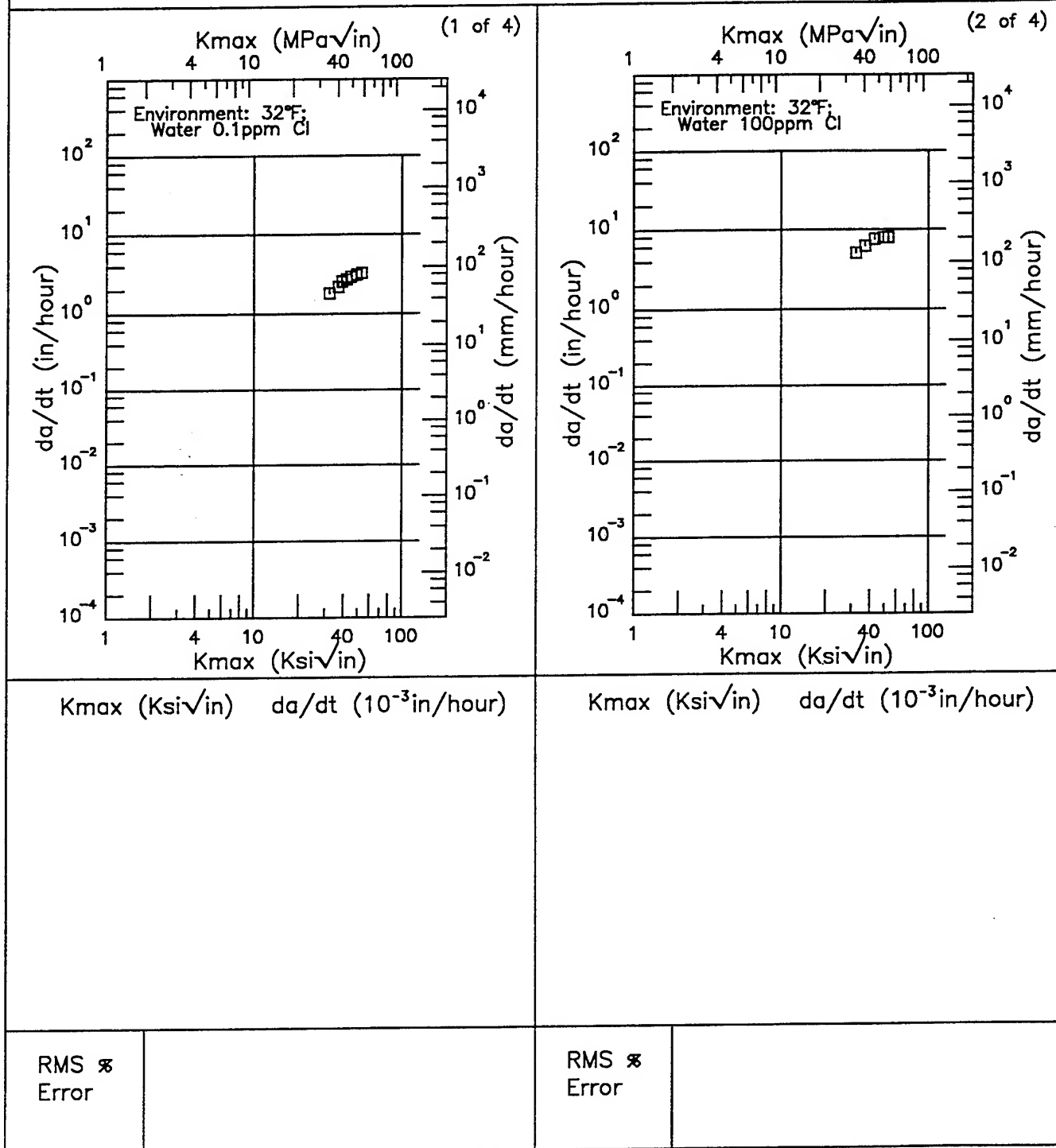


Figure 6.21.3.2.6

Condition/Ht: 1725F FC 1200F 3HR WQ  
 Form: 0.25 in. Plate  
 Specimen Type: CB  
 Orientation: T-L  
 Yield Strength: 150 ksi  
 Ult. Strength:

Specimen Thk: 0.25 in.  
 Specimen Width: 2 in.  
 A<sub>0</sub>: 0.25 in.  
 K<sub>Isc</sub>:  
 Ref: 85855

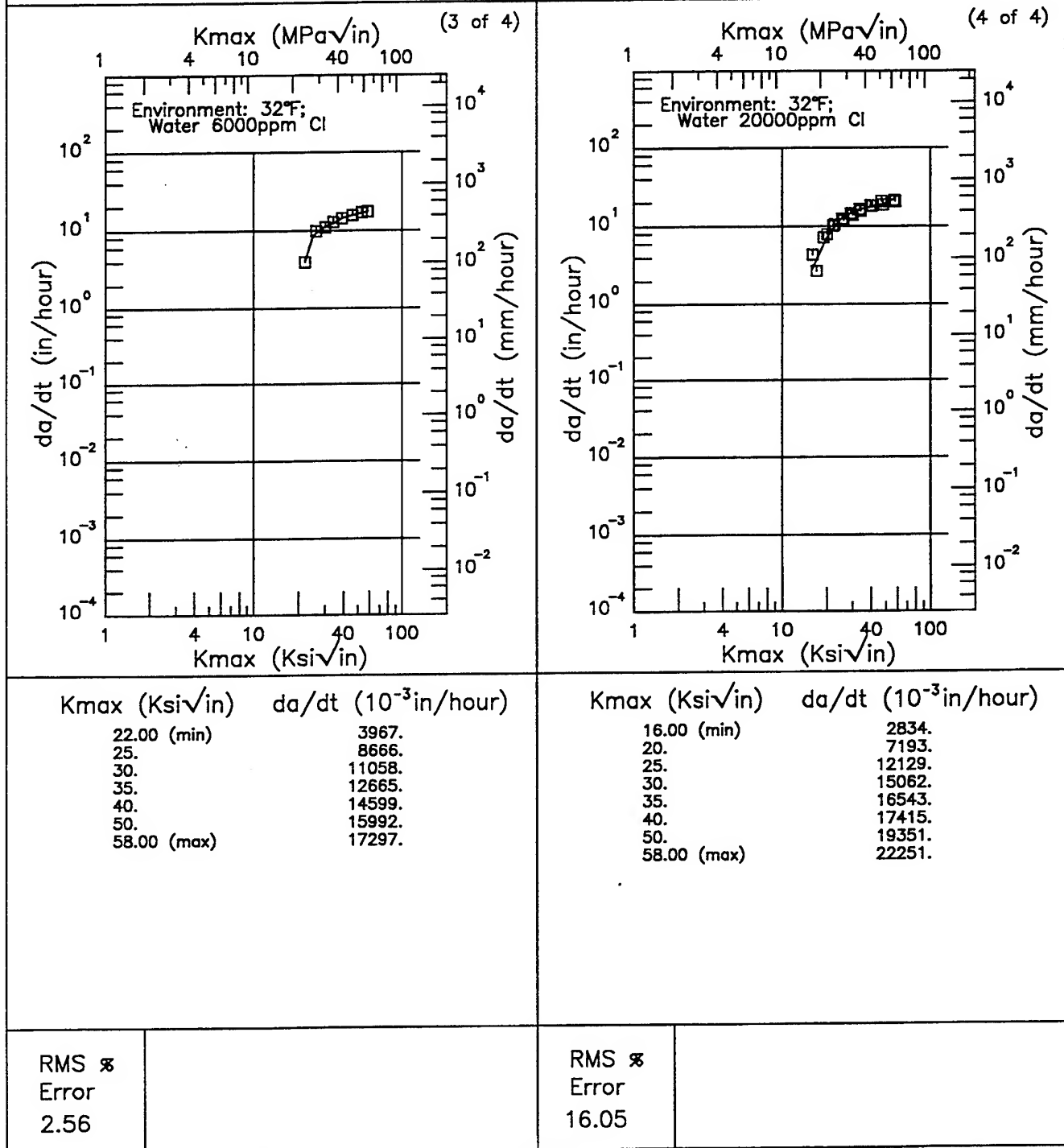
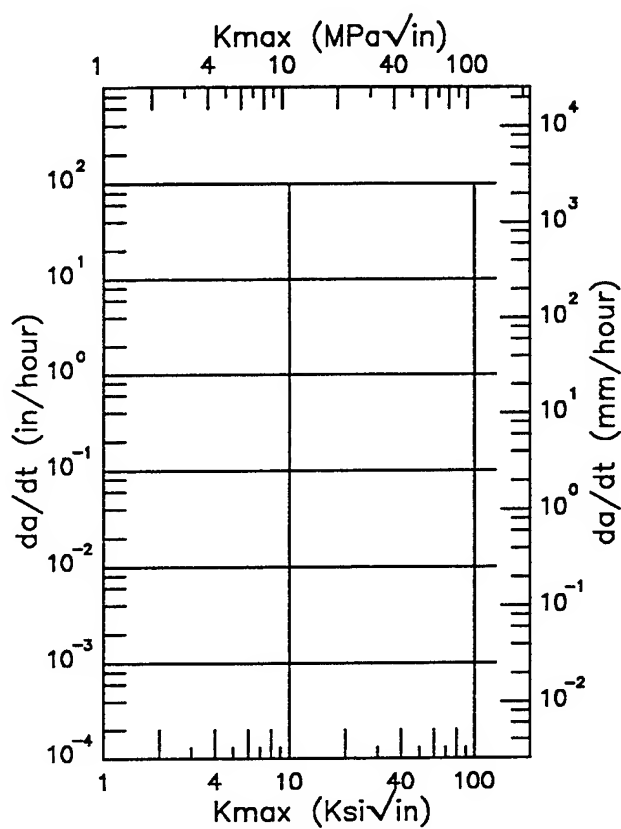
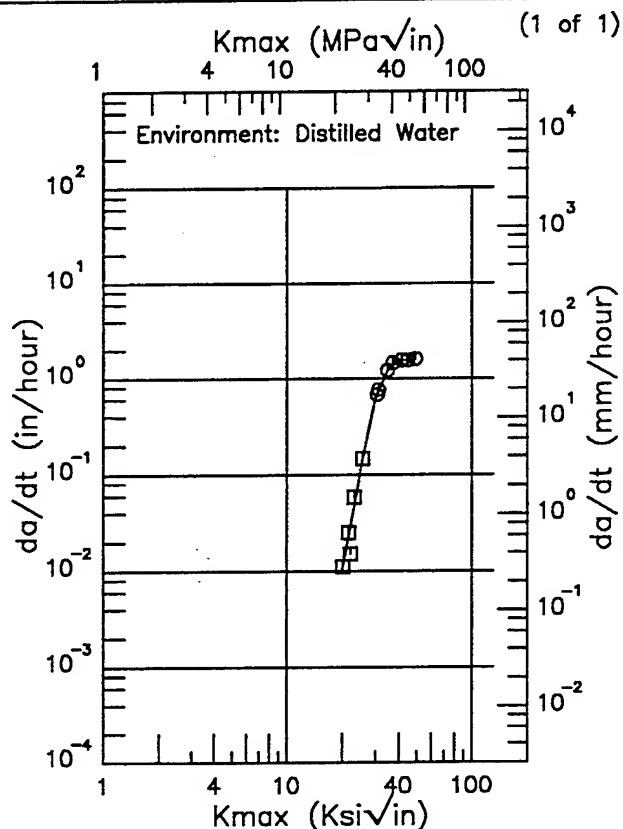


Figure 6.21.3.2.6 (Concluded)



Condition/Ht: MA  
Form: 0.27 in. Plate  
Specimen Type: SENT  
Orientation:  
Yield Strength:  
Ult. Strength:

Specimen Thk: 0.26 in.  
Specimen Width: 2 in.  
Ao:  
K<sub>I</sub>sc:  
Ref: 81741



Kmax (Ksi√in)	da/dt (10 <sup>-3</sup> in/hour)
20.00 (min)	10.3
25.	118.
30.	614.
35.	1261.
40.	1543.
49.00 (max)	1600.

Kmax (Ksi√in) da/dt (10<sup>-3</sup>in/hour)

RMS %  
Error  
16.05

RMS %  
Error

Figure 6.21.3.2.8



TABLE 6.21.3.3

K<sub>Isc</sub> SUMMARY FOR TITANIUM ALLOY Ti-8Al-1Mo-1V

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Crack (in)	K <sub>q</sub> (Ksi/in)	K <sub>Isc</sub> (Ksi/in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)						
Unspecified	S	R.T.	T-S	130	3.5% NaCl	CANT	1	0.125	---	54	18	---	1967	70931
	P	R.T.	---	---	3.5% NaCl	CANT	---	---	---	100	36*	---	1967	70887
1520° F 1hr WQ	P	-51	T-L	124	5 to 1 Solvent to Solute Ratio	DCB	1	0.25	0.99	95	20	---	1962	83689
		-15	T-L	124	Water LiCl	DCB	1	0.25	0.99	95	22.7	---	1962	83689
		12	T-L	124	CCl <sub>4</sub>	DCB	1	0.25	0.99	95	19.4	---	1962	83689
		27	T-L	124	Water LiCl	DCB	1	0.25	0.99	95	20.3	---	1962	83689
		36	T-L	124	Water LiCl	DCB	1	0.25	0.99	95	17	---	1962	83689
					Water LiCl 0.1M	DCB	1	0.25	0.99	95	23.1	---	1962	83689
					5 to 1 Solvent to Solute Ratio Water LiCl -1000MV	DCB	1	0.25	0.99	95	23.2	---	1962	83689
					Air	DCB	1	0.25	0.99	95	36	---	1962	83689
					CCl <sub>4</sub>	DCB	1	0.25	0.99	95	20	---	1962	83689
					Chloroform	DCB	1	0.25	0.99	95	21	---	1962	83689
R.T.	P		T-L	124	DMSO LiCl	DCB	1	0.25	0.99	95	19	---	1962	83689
					Glycerine	DCB	1	0.25	0.99	95	26	---	1962	83689
					Glycerine LiCl	DCB	1	0.25	0.99	95	19	---	1962	83689
					Hexamethyl-Phos- phoric Triamide	DCB	1	0.25	0.99	95	27.8	---	1962	83689

TABLE 6.21.3.3 (CONTINUED)

(2 of 7)

 $K_{Isc}$  SUMMARY FOR TITANIUM ALLOY Ti-8Al-1Mo-1V

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	$K_Q$ (Ksi√in)	$K_{Isc}$ (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)							
WQ	P	R.T.	T-L	124	Methanol	DCB	1	0.25	0.25	0.99	95	13.8	---	1962	83689
					Methanol LiCl	DCB	1	0.25	0.25	0.99	95	13	---	1962	83689
					Mixed Solvents 5 to 1 Solvent to Solute Ratio Formic Acid	DCB	1	0.25	0.25	0.99	95	25	---	1962	83689
					N n-Dimethyl- Acetamide	DCB	1	0.25	0.25	0.99	95	30.6	---	1962	83689
					Water	DCB	1	0.25	0.25	0.99	95	26	---	1962	83689
					Water 0.1M LiCl	DCB	1	0.25	0.25	0.99	95	24.8	---	1962	83689
					Water 9M LiCl 9M LiNO <sub>3</sub>	DCB	1	0.25	0.25	0.99	95	23.2	---	1962	83689
					Water HCl 1M TiCl <sub>3</sub>	DCB	1	0.25	0.25	0.99	95	16.3	---	1962	83689
					Water LiBr	DCB	1	0.25	0.25	0.99	95	19.5	---	1962	83689
					Water LiCl	DCB	1	0.25	0.25	0.99	95	14.7	---	1962	83689
					Water LiCl 0.6M NaCl -500MV	DCB	1	0.25	0.25	0.99	95	20	---	1962	83689
					Water LiCl -1000MV	DCB	1	0.25	0.25	0.99	95	17	---	1962	83689
					Water LiCl -200MV	DCB	1	0.25	0.25	0.99	95	15.5	---	1962	83689

TABLE 6.21.3.3 (CONTINUED)

K<sub>Iscc</sub> SUMMARY FOR TITANIUM ALLOY Ti-8Al-1Mo-1V

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	K <sub>q</sub> (Ksi√in)	K <sub>Iscc</sub> (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)							
WQ (cont'd)	P (cont'd)	R.T. (cont'd)	T-L (cont'd)	124 (cont'd)	Water LiCl - 200MV	DCB	1	0.25	0.25	0.99	95	19.9	---	1962	83689
					Water LiCl +500MV	DCB	1	0.25	0.25	0.99	95	27.7	---	1962	83689
					Water LiCl +2000MV	DCB	1	0.25	0.25	0.99	95	20.8	---	1962	83689
					Water LiCl +2000MV	DCB	1	0.25	0.25	0.99	95	20	---	1962	83689
					Water(1) Glycerine(4) LiCl	DCB	1	0.25	0.25	0.99	95	24.5	---	1962	83689
					Water(2.5) Glycerine (2.5) LiCl	DCB	1	0.25	0.25	0.99	95	18	---	1962	83689
					Water(3.4) DMSO(1.6) LiCl	DCB	1	0.25	0.25	0.99	95	19.5	---	1962	83689
					Water(4) Glycerine(1) LiCl	DCB	1	0.25	0.25	0.99	95	19	---	1962	83689
					Water 3.5% NaCl	DCB	1	0.25	0.25	0.99	95	21.4	---	1962	83689
		122	T-L	124	CCl <sub>4</sub>	DCB	1	0.25	0.25	0.99	95	19.5	---	1962	83689
		131	T-L	124	DMSO LiCl	DCB	1	0.25	0.25	0.99	95	25	---	1962	83689
		136	T-L	124	Methanol LiCl	DCB	1	0.25	0.25	0.99	95	19	---	1962	83689
		140	T-L	124	Water LiCl	DCB	1	0.25	0.25	0.99	95	21.8	---	1962	83689
		151	T-L	124	Acetone LiBr	DCB	1	0.25	0.25	0.99	95	30	---	1962	83689

TABLE 6.21.3.3 (CONTINUED)

(4 of 7)

**K<sub>Isc</sub> SUMMARY FOR TITANIUM ALLOY Ti-8Al-1Mo-1V**

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	K <sub>Q</sub> (Ksi√in)	K <sub>Isc</sub> (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)							
WQ (cont'd)	P (cont'd)	151 (cont'd)	T-L (cont'd)	124 (cont'd)	Water Ammonium Chloride	DCB	1	0.25	0.25	0.99	95	26	---	1962	83689
		194	T-L	124	Water 0.1M LiCl	DCB	1	0.25	0.25	0.99	95	30.2	---	1962	83689
					Water LiCl -1000MV	DCB	1	0.25	0.25	0.99	95	29	---	1962	83689
		203	T-L	124	Water LiCl +1000MV	DCB	1	0.25	0.25	0.99	95	21.3	---	1962	83689
					Water LiCl +2000MV	DCB	1	0.25	0.25	0.99	95	23.9	---	1962	83689
					Water LiCl 0MV	DCB	1	0.25	0.25	0.99	95	22.2	---	1962	83689
					Glycerine LiCl	DCB	1	0.25	0.25	0.99	95	26	---	1962	83689
		205	T-L	124	Water	DCB	1	0.25	0.25	0.99	95	42*	---	1962	83689
					Water LiCl	DCB	1	0.25	0.25	0.99	95	20.8	---	1962	83689
		212	T-L	124	Silicone Oil	DCB	1	0.25	0.25	0.99	95	65*	---	1962	83689
		235	T-L	124	Water LiCl	DCB	1	0.25	0.25	0.99	95	22.7	---	1962	83689
		412	T-L	124	Glycerine LiCl	DCB	1	0.25	0.25	0.99	95	26	---	1962	83689
1675°F 1hr AC 1075°F 8hr AC 1000°F 2hr AC	P	R.T.	T-L	138.9	3.5% NaCl	CANT	---	0.866	1	---	---	26.4	---	1981	NR001

TABLE 6.21.3.3 (CONTINUED)

K<sub>ISCC</sub> SUMMARY FOR TITANIUM ALLOY Ti-8Al-1Mo-1V

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	K <sub>Q</sub> (Ksi√in)	K <sub>ISCC</sub> (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)							
1700°F 1hr AC 1200°F 2hr WQ	P	R.T.	T-S	107.9	3.5% NaCl	CANT	1	0.5	1	---	112	28	---	1967	70931
1775°F 0.5hr FC to 1200°F 1200°F 0.5hr AC 1200°F 3hr Argon Quench	P	32	T-L	150	Water 21000PPM Chloride	CANT	2	0.25	0.25	0.2	65.4	17.7	---	1973	85855
		R.T.	T-L	150	Water 0.1PPM Chloride	CANT	2	0.25	0.25	0.2	59.5	24.2	---	1973	85855
					Water 100PPM Chloride	CANT	2	0.25	0.25	0.2	58.7	20.8	---	1973	85855
					Water 21000PPM Chloride	CANT	2	0.25	0.25	0.2	67.4	14	---	1973	85855
					Water 6000PPM Chloride	CANT	2	0.25	0.25	0.2	60.3	18.4	---	1973	85855
		140	T-L	150	Water 21000PPM Chloride	CANT	2	0.25	0.25	0.2	62.1	14.7	---	1973	85855
1825°F 1hr AC	P	200	T-L	150	Water 21000PPM Chloride	CANT	2	0.25	0.25	0.2	66.3	18.4	---	1973	85855
1825°F 1hr AC	P	R.T.	T-S	120.4	3.5% NaCl	CANT	1	0.5	1	---	88	23	---	1967	70931
2000°F 0.5hr AC	P	R.T.	T-L	115.1	3.5% NaCl	CANT	---	0.866	1	---	---	47.3	---	1981	NR001



TABLE 6.21.3.3 (CONTINUED)

(6 of 7)

 $K_{Isc}$  SUMMARY FOR TITANIUM ALLOY Ti-8Al-1Mo-IV

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Crack (in)	$K_Q$ (Ksi√in)	$K_{Isc}$ (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)						
Mill Annealed	P	R.T.	T-S	123	3.5% NaCl	NB	---	---	---	45	20*	---	1969	75386
						CANT*	1	0.1	---	75	46*	---	1967	84327
						CANT*	1	0.25	---	75	38	---	1967	84327
						CANT	1	0.25	---	75	61*	---	1967	84327
						CANT	1	0.5	---	83	41	---	1967	84327
						CANT*	1	0.5	---	83	41	---	1967	84327
						CANT*	1	1	---	83	38	---	1967	84327
						CANT	1	1	---	83	39	---	1967	84327
Mill Annealed 1435°F 8hr FC	S	R.T.	T-S	145	3.5% NaCl	CNT	8	0.16	0.8	36	21	---	1967	70733
				150	3.5% NaCl	SENT	3	0.125	0.13	55.5	22	---	1969	77456
VAC Annealed	P	R.T.	T-L	135	3.5% NaCl	CANT*	1	0.27	---	44	23	---	1968	84326
						CANT*	1	0.27	---	102	27	---	1968	84326
						CANT*	1	0.27	---	65	23	---	1968	84326
					Hexane	CANT*	1	0.27	---	65	34	---	1968	84326
						CANT*	1	0.27	---	44	34	---	1968	84326
					Methanol	CANT*	1	0.27	---	65	23	---	1968	84326
						CANT*	1	0.27	---	44	23	---	1968	84326

TABLE 6.21.3.3 (CONCLUDED)

 $K_{Isec}$  SUMMARY FOR TITANIUM ALLOY Ti-8Al-1Mo-1V

Condition/ Heat Treat	Prod Form	Test Temp (°F)	Spec Or.	Yield Str (Ksi)	Envir.	Specimen			Prod Thk (in)	Crack (in)	$K_Q$ (Ksi√in)	$K_{Isec}$ (Ksi√in)	Test Time (min)	Test Date	Refer
						Design	Width (in)	Thick (in)							
VAC Annealed (cont'd)	P (cont'd)	R.T. (cont'd)	T-L (cont'd)	135 (cont'd)	Methanol (cont'd)	CANT*	1	0.27	---	---	192	22	---	1968	84326

\* specimen thickness does not meet minimum requirements of  $2.5 \left( \frac{K_{Isec}}{\sigma_y} \right)^2$

\* asterisk in specimen design column indicates that specimens are side-grooved

TABLE 6.22.1.1

1 of 1

**MEAN PLANE STRAIN FRACTURE TOUGHNESS  
FOR TITANIUM ALLOY Ti-Mo8V2Fe3Al AT ROOM TEMPERATURE**

Product Form	Condition/Heat Treatment	$K_{Ic}$ (ksi $\sqrt{in}$ )							
		Specimen Orientation							
		L-T		T-L		S-L			
		Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev
Plate	STA REAGED AT 1100F 6HR	54	1.	3	53.9	1.	3	---	---
								---	---



TABLE 6.22.2.1

TITANIUM Ti-8Mo-8V-2Fe-3Al K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>IC</sub> TYS) <sup>a</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>IC</sub> (Ksi√in.)	K <sub>IC</sub> MEAN	STAN DEV		
1475F 1.5 HR WQ 1000F 8 HR AC	Extrusion	3.00	R.T.	---	155.0	1.498	0.750	CT	0.766	0.12	34.30	34.9	1.2	1973	87230
		3.00			155.0	1.498	0.750	CT	0.747	0.12	34.10			1973	87230
		3.00			155.0	1.500	0.750	CT	0.776	0.14	36.30			1973	87230
STA REAGED AT 1100F 6 HR	Plate	1.00	R.T.	L-T	170.0	1.989	0.998	CT	1.001	0.26	55.00	54.0	1.0	---	86429
		1.00			170.0	1.990	1.002	CT	0.994	0.24	53.10			---	86429
		1.00			170.0	1.995	1.005	CT	0.995	0.25	53.90			---	86429
STA REAGED AT 1100F 6HR	Plate	1.00	R.T.	T-L	177.0	1.991	0.991	CT	0.987	0.23	53.40	53.9	1.0	---	86429 (1)
		1.00			177.0	1.995	0.998	CT	1.008	0.24	55.00			---	86429 (1)
		1.00			177.0	1.993	0.996	CT	1.014	0.23	53.20			---	86429 (1)

NOTES: (1) COMPOSITION(WT PERCENT) 2.26Al, 7.99V, 8.17Mo, 0.022C, 0.018N, 0.0070H, 0.160, 0.006Cu  
 ALPHA PRECIPITATE IN BETA MATRIX  
 STRAIGHTNESS OF CRACK FRONT MAY NOT MEET ASTM E399-72 REQUIREMENTS

TABLE 6.23.2.1

TITANIUM Ti-5Al-2.5Sn ELI $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (ksi)	SPECIMEN			CRACK LENGTH (in.) A	$2.5 \cdot (K_{Ic}/\sqrt{S})^2$ (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ (ksi√in.)	$K_{Ic}$ MEAN	STAN DEV		
ANNEALED	Forging	---	-423	---	186.0	2.000	1.005	CT	1.060	0.32	66.60	67.5	4.4	1970	88439
		---			186.0	2.000	1.006	CT	1.040	0.27	61.10			1970	88439
		---			186.0	2.000	1.006	CT	1.010	0.32	66.30			1970	88439
		---			187.0	2.000	1.000	CT	0.960	0.40	74.50			1970	88439
		---			187.0	2.000	1.000	CT	0.930	0.34	69.30			1970	88439
		---			187.0	2.000	1.004	CT	1.020	0.32	67.00			1970	88439
ANNEALED	Forging	17.00	-423	R-L	189.0	2.000	1.000	CT	0.910	0.32	67.90	70.8	2.9	1970	88439
		17.00			189.0	2.000	1.000	CT	0.960	0.39	74.50			1970	88439
		17.00			189.0	2.000	1.000	CT	0.960	0.36	71.50			1970	88439
		17.00			189.0	2.000	1.000	CT	0.930	0.34	69.30			1970	88439
		17.00			189.0	2.000	1.000	CT	1.020	0.19	52.40			1970	88439
		17.00			189.0	2.000	1.000	CT	1.040	0.17	49.80			1970	88439
ANNEALED	Forging	17.00	-423	R-C	189.0	2.000	1.000	CT	1.000	0.23	57.30	53.2	3.8	1970	88439
		---			186.0	2.000	1.002	CT	1.010	0.36	70.80			1970	88439
		---			186.0	2.000	1.001	CT	1.060	0.35	70.00			1970	88439
		---			186.0	2.000	1.001	CT	1.010	0.35	69.80			1970	88439
		---			186.0	2.000	1.004	CT	1.020	0.36	71.20			1970	88439
		---			186.0	2.000	1.002	CT	1.020	0.35	69.80			1970	88439
ANNEALED EQUIAXED STRUCTURE	Forging	---	-423	---	186.0	2.000	1.003	CT	1.000	0.35	70.00	70.3	0.6	1970	88439
		---			186.0	2.000	1.003	CT	1.000	0.35	70.00			1970	88439
		---			186.0	2.000	1.003	CT	1.000	0.35	70.00			1970	88439
		---			186.0	2.000	1.003	CT	1.000	0.35	70.00			1970	88439
		---			186.0	2.000	1.003	CT	1.000	0.35	70.00			1970	88439
		---			186.0	2.000	1.003	CT	1.000	0.35	70.00			1970	88439

TABLE 6.23.2.1 (CONCLUDED)

2 of 2

TITANIUM Ti-5Al-2.5Sn ELI $K_{Ic}$															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (Ksi)	SPECIMEN			CRACK LENGTH (in.) A	$2.5 \cdot (K_{Ic}/TYS)^2$ (in.)	$K_{Ic}$			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			$K_{Ic}$ (Ksi/in.)	$K_{Ic}$ MEAN	STAN DEV		
ANNEALED INTERMEDIATE STRUCTURE BETWEEN PLATELET ALPHA AND FINE EQUIAXED GRAINS	Forging	...	-423	---	186.0	2.000	1.000	CT	1.010	0.56	88.20	79.2	6.6	1970	88439
		...			186.0	2.000	1.001	CT	1.020	0.50	83.30			1970	88439
		...			186.0	2.000	1.002	CT	1.020	0.37	71.70			1970	88439
		...			186.0	2.000	1.001	CT	0.990	0.41	75.20			1970	88439
		...			186.0	2.000	1.002	CT	1.060	0.44	77.60			1970	88439

TABLE 6.24.1.1

1 of 1

**MEAN PLANE STRAIN FRACTURE TOUGHNESS  
FOR TITANIUM ALLOY Ti-6Al6V2Sn ELI AT ROOM TEMPERATURE**

Product Form	Condition/Heat Treatment	$K_{Ic}$ (ksi $\sqrt{in}$ )									
		Specimen Orientation									
		L-T			T-L			S-L			
		Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	Mean $K_{Ic}$	Std Dev	n	
Plate	1600F 1 HR WQ 1050F 4HR AC	29.8	0.5	3	---	---	---	---	---	---	---
	1650F 1 HR WQ 1050F 4HR AC	34	3.5	2	---	---	---	---	---	---	---

TABLE 6.24.2.1

1 of 1

TITANIUM Ti-6Al-6V-2Sn ELI K <sub>Ic</sub>															
CONDITION	PRODUCT		TEST TEMP (°F)	SPEC OR	YIELD STR (KSI)	SPECIMEN			CRACK LENGTH (in.) A	2.5 • (K <sub>Ic</sub> /TYS) <sup>3</sup> (in.)	K <sub>Ic</sub>			DATE	REFER
	FORM	THICK (in.)				WIDTH (in.) W	THICK (in.) B	DESIGN			K <sub>Ic</sub> (KSI/in.)	K <sub>Ic</sub> MEAN	STAN DEV		
1600F 1 HR WQ 1050F 4HR AC		1.00			179.0	0.499	0.250	NB	0.184	0.07	30.10			1965	84316
	Plate	1.00	R.T.	L-S	179.0	0.499	0.250	NB	0.222	0.08	32.10	32.4	2.5	1965	84316
		1.00			179.0	0.499	0.251	NB	0.215	0.10	35.10			1965	84316
1600F 1 HR WQ 1050F 4 HR AC		1.00			178.0	0.499	0.250	NB	0.177	0.07	30.20			1965	84316
	Plate	1.00	R.T.	L-T	179.0	0.499	0.255	NB	0.200	0.07	30.00	29.8	0.5	1965	84316
		1.00			178.0	0.499	0.247	NB	0.223	0.07	29.20			1965	84316
1650F 1 HR WQ 1125F 4 HR AC	Plate	1.00	-320	L-S	258.0	0.499	0.250	NB	0.206	0.02	22.60	23.7	1.5	1965	84316
		1.00			258.0	0.499	0.250	NB	0.221	0.02	24.70			1965	84316
1650F 1 HR WQ 1125F 4 HR AC	Plate	1.00	R.T.	L-S	170.0	0.499	0.250	NB	0.191	0.12	37.50	38.1	0.8	1965	84316
		1.00			170.0	0.499	0.250	NB	0.205	0.13	38.60			1965	84316
1650F 1 HR WQ 1125F 4 HR AC	Plate	1.00	R.T.	L-T	170.0	0.499	0.251	NB	0.219	0.11	36.50	34.0	3.5	1965	84316
		1.00			170.0	0.499	0.248	NB	0.191	0.09	31.50			1965	84316

**TABLE 6.25**

**REFERENCES FOR THE TITANIUM ALLOY DATA**

54304	Ti-6Al-4V	$K_{IC}$	Figge, I. E., "Residual Static Strength of Several Titanium and Stainless Steel Alloys and One Superalloy at - 109 F, 70 F, and 550F," NASA TN D-2045, Langley Research Center (December 1963).
57573	Ti-6Al-4V	$K_{IC}$	Anon., "Fracture Toughness and Tear Tests," Air Force Materials Laboratory, Research and Technology Division, Report No. ML-TDR-64-238, October 1964.
58782	Ti-6Al-4V	$K_{IC}$	Anon., "Thick Section Fracture Toughness," ML-TDR-64-236, Boeing-North American (October 1964).
60578	Ti-6Al-4V ELI	$K_{IC}$	Christian, J. L., Yang, C. T., and Witzell, W. E., "Physical and Mechanical Properties of Pressure Vessel Materials for Application in a Cryogenic Environment," ASD-TDR-62-258, Part III, General Dynamics/Astronautics (December 1964).
66103	Ti-5Al-2.5Sn	$K_{IC}$	Ferguson, C. W., "Hypervelocity Impact Effects on Liquid Hydrogen Tanks," NASA CR-54852, Douglas Aircraft Co., Inc. (March 1966).
66218	Ti-5Al-2.5Sn	$K_{IC}$	Tiffany, C. F., Lorenz, P. M., and Hall, L. R., "Investigation of Plane-Strain Flaw Growth in Thick-Walled Tanks," NASA CR-54837, The Boeing Company, (February 1966).
67821	Ti-8Al-1Mo-1V	$K_{IC}$	Walker, E. K., "A Study of the Influence of Geometry on the Strength of Fatigue Cracked Panels," AFFDL-TR-66-92, Northrop Norair (June 1966).

**TABLE 6.25 (CONTINUED)**

**REFERENCES FOR THE TITANIUM ALLOY DATA**

68968	Ti-5Al-2.5Sn	$K_I$	Sullivan, T. L., "Uniaxial and Biaxial Fracture Toughness of Extra-Low-Interstitial 5Al-2.5Sn Titanium Alloy Sheet at 20 K," NASA TN D-4016, Lewis Research Center, (June 1967).
70733	Ti-8Al-1Mo-1V	$K_{Isc}$	Smith, H. R., et al., "A Study of Stress Corrosion Cracking by Wedge-Force Loading," Report D6-19768, The Boeing Company, Renton, Wash., Contract N00014-66-C-0365, (June 1967).
70887	Ti-6Al-4V Ti-6Al-6V-2.5Sn Ti-8Al-1Mo-1V	$K_{Isc}$ $K_{Isc}$ $K_{Isc}$	Peterson, M. H., Brown, B. F., Newbegin, R. L., and Groover, R. E., "Stress Corrosion Cracking of High Strength Steels and Titanium Alloys in Chloride Solutions at Ambient Temperature," Corrosion, <u>23</u> (5), 142-148 (May 1967).
70931	Ti-6Al-4V Ti-6Al-4V ELI Ti-6Al-6V-2.5Sn Ti-8Al-1Mo-1V	$K_{Isc}$ $K_{Isc}$ $K_{Isc}$ $K_{Isc}$	Judy, Jr., R. W., and Goode, R. J., "Stress-Corrosion Cracking Characteristics of Alloys of Titanium in Salt Water," Interim Report 6564, Naval Research Laboratory, Washington, D. C., Contracts NONR-610(09), NONR-760(31) and N00014-66-C0365 (July 21, 1967).
71709	Ti-8Al-1Mo-1V	$K_I$	Figge, I. E., "Residual-Static-Strength and Slow-Crack-Growth Behavior of Duplex-Annealed Ti-8Al-1Mo-1V Sheet," NASA TN D-4358, Langley Research Center, (March 1968).
74355	Ti-6Al-4V	$K_{Isc}$	Stanley, J. K., "Solutions to Some Stress Corrosion Cracking Problems in Aerospace Applications," Technical Report TR-0200 (4112.22)-1, Aerospace Corporation, El Segundo, Calif., Contract F04701-68-C-0200 (November 1968).

TABLE 6.25 (CONTINUED)

REFERENCES FOR THE TITANIUM ALLOY DATA

75386	Ti-4Al-3Mo-1V	$K_{Isc}$
	Ti-6Al-4V	$K_{Isc}$
	Ti-8Al-1Mo-1V	$K_{Isc}$
Curtis, R. E., et al., "Relationship Between Composition, Micro-structure, and Stress Corrosion Cracking (In Salt Solution) In Titanium Alloys," ASM Transactions Quarterly, 62 (2), 457-469 (June 1969).		
75528	Ti-6Al-4V	$K_{Isc}$
Bixler, W. D., "Fracture Characteristics of 6Al-4V Titanium Alloy Forgings Containing Alpha Stringer Microstructure," NASA Final Report CR-99512, The Boeing Company, Seattle, Wash., Contract NAS-9-8809 (January 1969).		
76411	Ti-6Al-4V	$K_{Ic}$
Wessel, E. T., et al., "Engineering Methods for the Design and Selection of Materials Against Fracture," Final Technical Report, Westinghouse Research Laboratories, Pittsburgh, PA., Contract DA-30-069-AMC-602 (T) (June 24, 1966).		
77290	Ti-6Al-4V	$K_{Isc}$
Reuter, W. G., et al., "Monitoring of Crack Growth on Ti-6Al-4V Alloy by the Stress Wave Analysis Technique," NASA Report CR-101888, Aerojet General Corporation, Sacramento, Calif. (December 1968).		
77456	BETA	$K_{Isc}$
	BETA Ti	$da/dt$
	Ti-8Al-1Mo-1V	$da/dt; K_{Isc}$
Katz, Y., "Micro-Mechanical Approach to Stress Corrosion Cracking in Titanium Alloys," Thesis Report No. UCRL-19046, University of California, Lawrence Radiation Laboratory, Berkeley, Calif., AEC Contract W-7405-eng-48 (September 1969).		
78535	Ti-6Al-4V	$K_{Isc}$
Masters, J. N., et al., "Fracture and Nitrogen Tetroxide/Sustained Load Flaw Growth in 6Al-4V Titanium," Final Report D2-121397-1, NASA CR-109366, The Boeing Company, Seattle, Wash., Contract NAS7-100 (October 1969).		



**TABLE 6.25 (CONTINUED)**

**REFERENCES FOR THE TITANIUM ALLOY DATA**

80104	Ti-5Al-2.5Sn	$K_{Ic}$	Orange, T. W., Sullivan, T. L., and Calfo, F. D., "Fracture of Thin Sections Containing Through and Part-Through Cracks," NASA TN D-6305, Lewis Research Center (April 1971).
80538	Ti-6Al-4V	$K_{Ic}$	Petrak, G. J., "Mechanical Property Evaluation of Beta Forged Ti-6Al-4V," Report AFML-TR-70-291, University of Dayton Research Institute, Dayton, Ohio, Contract F33615-69-C-1471 (January 1971).
81221	Ti-6Al-4V	$da/dt$ ; $K_{Isc}$	Beck, T. R., et al., "Stress Corrosion Cracking of Titanium Alloys: Studies of Cracks in Thin Specimens; SCC of Ti-6Al-4V in Chloride, Iodide and Fluoride Solutions; Stress Corrosion Cracking in Molten Salts; Electrochemistry of Freshly Generated Titanium Surfaces," Report 20, The Boeing Company, Seattle, Wash., Contract NAS 7-489, (June 1971).
81741	Ti-8Al-1Mo-1V	$da/dt$	Bucci, R. J., and Paris, P. C., "Observations on Sustained Load Environmental Crack Growth of Titanium 8Al-1Mo-1V Alloy," Corrosion, <u>27</u> (12) 525-530 (December 1971).
82651	BETA BETA III Ti-8Al-1Mo-1V	$K_{Isc}$ $da/dt$ ; $K_{Isc}$ $da/dt$	Beck, T. R., and Blackburn, M. J., "Stress Corrosion Cracking of Titanium Alloys; SCC Velocity; Concentration of $TiCl_3$ ," Report 18, The Boeing Company, Seattle, Wash., Contract NAS 7-489 (December 1970).
83222	Ti-6Al-6V-2Sn	$K_{Ic}$	Amateau, M. F., et al., "F-15 Program Final Report Ti-6Al-6V-2Sn and Ti-6Al-4V Fatigue Crack Propagation," Report No. ATR-72(9990)-3, The Aerospace Corporation, El Segundo, Calif. (September 29, 1971).

TABLE 6.25 (CONTINUED)

REFERENCES FOR THE TITANIUM ALLOY DATA

- |       |                                 |                      |  |
|-------|---------------------------------|----------------------|--|
| 83689 | Ti-8Al-1Mo-1V                   | $da/dt; K_{Isc}$     | Beck, T. R., et al., "Fundamental Investigation of Stress Corrosion Cracking," Report D180-15006-1, The Boeing Company, Aerospace Group, Seattle, Washington, Contract NASW-2245 (April 1962).   |
| 83984 | Ti-6Al-4V                       | $K_{Ic}$             | Feddersen, C. E., and Hyler, W. S., "Fracture and Fatigue-Crack-Propagation Characteristics of 1/4-Inch Mill-Annealed Ti-6Al-4V Titanium Alloy Plate," Report G-9706, Battelle, Columbus Laboratories, Columbus, Ohio, Contract N00156-70-C-1336 (November 1, 1971). |
| 84036 | Ti-6Al-4V                       | $K_{Isc}$            | Beachem, C. D., and Meyn, D. A., "The Effect of Thickness Upon Sustained Load Crack Propagation in Ti-6Al-4V Alloy Tested in 3.5% NaCl Solution," NRL Report 7449, Naval Research Laboratory, Washington, D. C. (August 8, 1972).                                    |
| 84282 | Ti-6Al-4V                       | $K_{Isc}$            | Spurr, W. F., "SST Technology Follow-On Program, Phase I, Titanium Alloy 6Al-4V Extrusion," Report No. FAA-SS-72-06, Boeing Report D6-60206, The Boeing Company, Commercial Airplane Group, Seattle, Wash., Contract No. DOT-FA-SS-71-12, (July 1972).               |
| 84290 | Ti-8Al-1Mo-1V                   | $da/dt$              | Smith, H. R., Piper, D. E., and Downey, F. K., "A Study of Stress-Corrosion Cracking by Wedge Force Loading," Engineering Fracture Mechanics, <u>1</u> , p 123-128 (1968), Pergamon Press.   |
| 84306 | Ti-6Al-4V                       | $K_{Ic}$             | Harrigan, M. J., "B-1 Fracture Mechanics Data for Air Force Handbook Usage," Report TFD-72-501, North American Rockwell, Los Angeles Division, Los Angeles, CA (April 21, 1972).   |
| 84316 | Ti-6Al-6V-2Sn<br>Ti6Al6V2Sn ELI | $K_{Ic}$<br>$K_{Ic}$ | DeSisto, T. S., and Hickey, Jr., C. F., "Low-Temperature Mechanical Properties and Fracture Toughness of Ti-6Al-6V-2Sn," ASTM Proceedings, <u>65</u> , 641-653 (1965).   |

## TABLE 6.25 (CONTINUED)

### REFERENCES FOR THE TITANIUM ALLOY DATA

84326	Ti-8Al-1Mo-1V	$K_{Isc}$	Report of NRL Progress, Naval Research Laboratory, Washington, D. C., (May 1968).
84327	Ti-8Al-1Mo-1V	$K_{Isc}$	Report of NRL Progress, Naval Research Laboratory, Washington, D. C., (May 1967).
84328	Ti-6Al-4V	$K_{Isc}$	Report of NRL Progress, Naval Research Laboratory, Washington, D. C., (November 1968).
84360	Ti-6Al-4V Ti-6Al-6V-2.5Sn Ti-6Al-6V-2Sn	$K_{Ic}$ ; $da/dN$ ; $da/dt$ ; $K_{Isc}$ $K_{Isc}$ $K_{Ic}$ ; $da/dN$ ; $da/dt$	McDonnell Aircraft Company, McDonnell Douglas Corp., St. Louis, Mo., Phase B Test Program, Report MDC A0913 (May 18, 1971).
85034	Ti-6Al-4V	$K_{Ic}$	Mitchell, John, "Laboratory Reports on Fracture Toughness Tests," per memo from Ed Cawthorne of February 5, 1973; data sheets from Schultz Steel Co., South Gate, CA.
85064	Ti-6Al-4V	$K_{Ic}$	Bjeletich, J. G., "Development of Engineering Data on Thick-Section Electron-Beam-Welded Titanium," Report N-LJ-71-18, Lockheed Aircraft Corporation, Lockheed Palo Alto Research Laboratory, Palo Alto, Calif., Contract F33615-71-C-1338, (October 12, 1972).
85634	Ti-6Al-4V	$K_{Ic}$	"Fracture Toughness and Tensile Properties Data for Ti-6Al-4V Forgings," Schultz Steel Company, South Gate, Calif., Attached to memo from Ed Cawthorne dated March 5, 1973.
85836	Ti-6Al-4V	$K_{Ic}$	"B-1 Fracture Toughness Data ( $K_{Ic}$ ) - Rockwell International," Rockwell International Corporation, Los Angeles, CA (April 24, 1973).

TABLE 6.25 (CONTINUED)

REFERENCES FOR THE TITANIUM ALLOY DATA

- |       |  |                  |
|-------|--|------------------|
| 85837 | Ti-6Al-4V  | a-vs-N; da/dN    |
|       | "Fracture Toughness Data Collection, Rockwell International Corporation, from B-1 Program," Rockwell International Corporation, Los Angeles, CA., April 1973.  |                  |
| 85855 | Ti-8Al-1Mo-1V  | da/dt; $K_{Isc}$ |
|       | Boyd, J. D., "Stress-Corrosion Cracking of Ti-8Al-1Mo-1V in Aqueous Environments: 1. The Kinetics of Subcritical Crack Propagation," Metallurgical Transactions, <u>4</u> (4) 1029-1035 (April 1973).            |                  |
| 85857 | Ti-6Al-4V  | $K_{Ic}$         |
|       | "Shultz Steel Company - Fracture Toughness Data - May 10, 1973," per memo from Ed Cawthorne of May 10, 1973.   |                  |
| 86099 | Ti-8Al-1Mo-1V  | a-vs-N; da/dN    |
|       | Wanhill, R. J. H., "A Review and Analysis of Fatigue Crack Propagation in Titanium Alloys at Room Temperature," Report No. NRL-TR-71035U, National Aerospace Laboratory, The Netherlands (February 1971).        |                  |
| 86429 | Ti-Mo8V2Fe3Al  | $K_{Ic}$         |
|       | "Fracture Toughness Data," Progress Report on Materials Test Program, General Dynamics Corporation, Fort Worth Division, Fort Worth, Texas, Contract F33615-72-C-2149 (Received July 6, 1973).                   |                  |
| 86494 | Ti-6Al-6V-2Sn  | $K_{Ic}$         |
|       | Harmsworth, C. L., "Evaluation Report - Fracture Toughness Evaluation of Isothermally Forged Ti-6Al-6V-2Sn STA," Report MXE 72-64, Air Force Materials Laboratory, WPAFB, Ohio (November 15, 1972).              |                  |
| 86575 | Ti-6Al-4V  | a-vs-N; da/dN    |
|       | "Rockwell International, B-1 Program, da/dN Data, Center-Cracked Tension Specimens," Lockheed California Company, Burbank, CA, Report LR25152 (Received July 1973) (Memo from Ed Cawthorne dated July 10, 1973). |                  |

## TABLE 6.25 (CONTINUED)

### REFERENCES FOR THE TITANIUM ALLOY DATA

86688	Ti-6Al-4V	$K_{Ic}$ ; $K_{Isc}$	Sprowls, D. O., et al., "Evaluation of Stress Corrosion Cracking Susceptibility Using Fracture Mechanics Techniques," Final Report Part I, Aluminum Co. of America, Alcoa Technical Center, Alcoa, Pa., Contract NASA-21487, May 31, 1973.
86844	Ti-6-2-2-2-2 Ti-6Al-6V-2Sn	a-vs-N; da/dN a-vs-N; da/dN	"Crack Growth Rate Data Generated Under USAF Contract F33615-72-C-2165," Lockheed Aircraft Corporation, Lockheed-Georgia Company, Marietta, GA, Contract F33615-72-C-2165, Data Sheets received from AFFDL August 13, 1973.
87230	BETA III Ti-6Al-6V-2Sn Ti-Mo8V2Fe3Al	$K_{Ic}$ $K_{Ic}$ $K_{Ic}$	DeSisto, T. S., "Fracture Toughness Measurements of Three Titanium Alloy Extrusions," Report AMMRC-TR-73-31, Army Materials and Mechanics Research Center, Watertown, MA (July 1973).
88140	Ti-6Al-4V Ti-6Al-4V ELI	da/dN da/dN	Hall, L. R., Finger, R. W., and Spurr, W. F., "Corrosion Fatigue Crack Growth in Aircraft Structural Materials," Report AFML-TR-73-204, Boeing Aerospace Company, Seattle, WA. Contract AF33615-71-C-1687 (September 1973).
88144	BETA III Ti-6Al-4V	$K_{Ic}$ ; da/dN $K_{Ic}$ ; da/dN; da/dt	Bjeletich, J. G., "Development of Engineering Data in Thick-Section Electron Beam Welded Titanium," Report AFML-TR-73-197, Lockheed Missiles and Space Company, Inc., Palo Alto, CA, Contract F33615-71-C-1338 (August 1973).
88186	TI-* Ti-6Al-6V-2Sn	$K_{Ic}$ $K_{Ic}$	"Selected Pages from Materials Section of Final Report on Cargo/Tanker Phase IA (AFFDL-TR-73-51) Lockheed Report SMN 378," Summary Report, Lockheed-Georgia Company, Marietta, GA, Contract F33615-72-C-2165 (February 8, 1974).

TABLE 6.25 (CONTINUED)

REFERENCES FOR THE TITANIUM ALLOY DATA

- |       |   |  |
|-------|---|--|
| 88439 | Ti5Al2.5Sn ELI  | $K_{Ic}$   |
|       | Reuter, W. G., "Fracture Toughness of Ti-5Al-2.5Sn ELI Forgings at -423 F," Summary Report, Aerojet-General Corporation, Sacramento, CA (September 9, 1970).  |  |
| 88440 | Ti-6Al-4V   | $K_{Ic}$   |
|       | "Titanium-6Al-4V Fracture Toughness and Tensile Test Data of December 19, 1973," Memo E. W. Cawthorne with fracture toughness data from Schultz Steel Company (December 19, 1973).  |  |
| 88468 | Ti-6Al-4V   | a-vs-N; da/dN  |
|       | Bell, P. D., "Data Sheets for Constant Amplitude Crack Growth Data Generated by Grumman Aerospace Corporation for 2219-T851 Aluminum and Mill Annealed 6Al-4V Titanium Alloy Plate," letter to J. E. Campbell from Grumman Aerospace Corporation, Bethpage, NY, Contract F33615-72-C-1744 (March 15, 1974). |  |
| 88575 | BETA C<br>Ti-6Al-4V   | $K_{Ic}$ ; a-vs-N; da/dN<br>$K_{Ic}$ ; a-vs-N; da/dN |
|       | "Advanced Metallic Air Vehicle Structure Program," Material Property Data Test Report Phase II, Report FZM-6148A, General Dynamics, Convair Aerospace Division, Fort Worth, TX, Contract AF33615-73-C-3001 (January 1974).  |  |
| 88579 | Ti-6Al-4V   | a-vs-N; da/dN  |
|       | "B-1 Program da/dN Data for Aluminum Alloys," Rockwell International Corporation, memorandum to H. D. Moran from E. W. Cawthorne, Battelle's Columbus Laboratories (April 3, 1974).   |  |
| 88700 | Ti-6Al-4V   | $K_{Isc}$  |
|       | Gilbreath, W. P., and Adamson, M. J., "The Stress Corrosion Susceptibility of Several Alloys in Hydrazine Fuels," NASA Technical Note, Report NASA TN D-7604, Ames Research Center, Moffett Field, CA (February 1974).  |  |
| 88911 | Ti-5Al-2.5Sn  | a-vs-N; da/dN  |
|       | Wanhill, R. J. H., et al., "Fatigue Crack Propagation Data for Titanium Sheet Alloys - Interim Report No. 3:Ti-5Al-2.5Sn," Report NLR TR 72093 U, National Aerospace Laboratory, the Netherlands (July 1972).   |  |

**TABLE 6.25 (CONTINUED)**

**REFERENCES FOR THE TITANIUM ALLOY DATA**

88962	Ti-6Al-4V	$K_{Ic}$
	Ti-6Al-6V-2Sn	$K_{Ic}$
	Ti-6Al2Sn4Zr6Mo	$K_{Ic}$
<p>Sparks, R. B., and Long, J. R., "Improvement Manufacturing Methods for Producing High Integrity More Reliable Titanium Forgings," Report AFML-TR-73-301, Wyman-Gordon Company, Worchester, MA, Contract AF33615-71-C-1560 (February 1974).</p>		
89004	Ti-6Al-4V	$K_{Ic}$ ; $K_{Isc}$
<p>"Rockwell International, B-1 Program Titanium <math>K_{Ic}</math>, <math>K_{Ic}</math>, and <math>K_{Isc}</math> Data for HB-01 Revision," with data attached to memorandum from E. W. Cawthorne to H. D. Moran (May 1, 1974).</p>		
89504	Ti-6Al-4V	$K_{Ic}$
<p>Cervay, R. R., "Mechanical Properties of Ti-6Al-4V Annealed Forgings," Report AFML-TR-74-49, University of Dayton Research Institute, Dayton, OH, Contract F33615-72-C-1282 (March 1974).</p>		
90012	Ti-6Al-4V	$K_{Ic}$
<p>"Ti-6Al-4V Fracture Toughness Data - Shultz Steel Company, South Gate, CA, of August 8, 1974," with memorandum from E. W. Cawthorne to H. D. Moran of Battelle's Columbus Laboratories (August 8, 1974).</p>		
90584	Ti-6Al-4V	$K_{Ic}$
	Ti-6Al-6V-2Sn	$K_{Ic}$
<p>DeMay, S., "Improved Fracture Toughness of Titanium," Final Report, Grumman Aerospace Corporation, Bethpage, NY, Contract N62269-73-C-0127 (June 1973) (AD 778 652).</p>		
90589	Ti-6Al-6V-2Sn	$K_{Ic}$
<p>Fiftal, C. F., and Beck, E. J., "Development of Fracture Mechanics Data for 6Al-6V-2Sn Titanium Alloy," Report MCR-74-43, Martin Marietta Corp., Denver Division, Denver, CO, Contract NAS 9-13599 (January 1974).</p>		

TABLE 6.25 (CONTINUED)

REFERENCES FOR THE TITANIUM ALLOY DATA

90981	Ti-6Al-4V Ti-6Al-6V-2Sn	a-vs-N; da/dN $K_{Ic}$ ; a-vs-N; da/dN
	Krupp, W. E., Wimmer, F. T., Pettit, D. E., and Hoepfner, D. W., Data Sheets for Final Report on "Investigation of the Effects of Stress and Chemical Environments on the Prediction of Fracture in Aircraft Structural Materials," Rye Canyon Research Laboratory, Lockheed-California Company, Burbank, CA, Contract F33615-71-C-1688, data sheets received October 21, 1974.	
91332	Ti-6Al-4V	da/dN
	Wells, R. R., "New Alloys for Advanced Metallic Fighter-Wing Structures," Northrop Corporation, Aircraft Division, Hawthorne, CA, AIAA/ASME/SAE 15th Structures, Structural Dynamics and Materials Conference, Las Vegas, NV (April 17-19, 1974).	
91793	BETA III	$K_{Ic}$
	Van Stone, R. H., Low, J. R. Jr., and Shannon, J. L., Jr., "The Effect of Microstructure on the Fracture Toughness of Titanium Alloys," NASA Technical Report No. 2-Ti, Carnegie-Mellon University, Pittsburgh, Pa., and NASA, Lewis Research Center, Cleveland, Ohio, Research Grant NGR 39-087-047 (December 1974).	
91945	Ti-6Al-6V-2Sn	da/dN
	Kondas, K. R., et al., "Cyclic-Crack-Growth and Fracture Resistance of Ti-6Al-6V-2Sn as Influenced by Recrystallization Anneal and Interstitial Oxygen Content," NRL Report 7844, Naval Research Laboratory, Washington, D. C. (January 8, 1975).	
GD007	Ti-6Al-4V	a-vs-N; da/dN
	Margolis, W. S., "F-16 Material Allowables Evaluating Beta Annealed 6Al-4V Titanium Alloy," General Dynamics, Fort Worth Division, Report No. 16PR944, September 1978.	
GE006	Ti-8Al-1Mo-1V	da/dN
	"Fatigue Crack Growth Rate Data on Titanium Ti-8-1-1 Alloy Using $K_{Ic}$ Bar Specimens from the TF34 DTA Effort". Data Sent from M. S. Gilbert, General Electric Co., Evendale, Ohio, October 1982.	



TABLE 6.25 (CONTINUED)

REFERENCES FOR THE TITANIUM ALLOY DATA

GE007	Ti-6Al-4V	da/dN	"Fatigue Crack Growth Rate Data on Titanium Ti-6-4 Alloy Using Kb Bar Specimens from the TF34 DTA Effort," Data sent from M. S. Gilbert, General Electric Co., Evendale, Ohio, October 1982.
JEM01	Ti-6Al-4V Ti-6Al-6V-2Sn	$K_{Ic}$ $K_{Ic}$	Yoder, G. R., Cooley, L. A., and Crooker, T. W., "Enhancement of Fatigue Crack Growth and Fracture Resistance in Ti-6Al-4V and Ti-6Al-6V-2Sn Through Micro-Structural Modification," Journal of Engineering Materials and Technology, Vol. 99, pp. 315-318, October 1977.
MA002	Ti-6Al-4V Ti-6Al-6V-2Sn	$K_{Ic}$ ; a-vs-N; da/dN a-vs-N; da/dN	Fracture Toughness of Ti-6Al-4V Plate and Forging, Aluminum 2124-T851 Plate and 7175-T37652 Forging and Fatigue Crack Growth Rate for Ti-6Al-4V Plate and Forging, Ti-6Al-6V-2Sn Extrusion, Aluminum 2124-T851 Plate and Aluminum 7175-T73652 Forging, Data Submitted by D. L. Rich of McDonnell Aircraft Co., St. Louis, MO, Attachment #2, Received March 12, 1982.
MA003	Ti-6Al-4V	$K_{Ic}$ ; a-vs-N; da/dN	Seay, S., and Krieg, J. F., "Wing Carry Through Lug Joint Crack Growth Tests," McDonnell Aircraft Co., St. Louis, MO, Report MDC A3449, Attachment #3, Submitted by D. L. Rich, March 12, 1982.
MA005	Ti-6Al-4V	da/dN; $K_{Isc}$	Garland, K., and Krieg, J. F., "Final Report - Basic Fracture Data for F-18 Material," McDonnell Aircraft Company, St. Louis, MO, Report No. 3 NA-66-7KW, Attachment #5, March 1977.
MA006	Ti-6Al-4V	da/dN	Garland, K., and Krieg, J. F., "Evaluation of the Effect of Material Cyclic Softening and Hardening on Crack Initiation Life and Crack Growth, with and without Overloads as a Function of Stress Ratio," McDonnell Aircraft Company, St. Louis, MO, April 1978.

TABLE 6.25 (CONTINUED)

REFERENCES FOR THE TITANIUM ALLOY DATA

MA011	Ti-8Al-1Mo-1V	da/dN	"Final Report, F/RF-4C/D Damage Tolerance and Life Assessment Study - Vol. II," McDonnell Aircraft Company, St. Louis, MO, Contract No. AFSC F33657-73-A-0062, Report No. MDC A2883, February 1975.
NC001	Ti-6Al-4V Ti-6Al-4V ELI	$K_{Ic}$ $K_{Ic}$	"Plane Strain Fracture Toughness Data Sets on Aluminum, Steel, and Titanium Alloys," Data sent from P. G. Porter of Northrop Corp., Hawthorne, CA, March 1, 1982.
NC002	Ti-6Al-4V Ti-6Al-4V ELI	a-vs-N; da/dN a-vs-N; da/dN	"Fatigue Crack Growth Rate Data on Aluminum, Steel, and Titanium Alloy," Data sent from P. G. Porter, Northrop Corp., Hawthorne, CA, March 1, 1982.
NL001	Ti-6Al-4V	a-vs-N; da/dN	Data Sheets on Ti-6Al-4V - Fatigue Crack Growth Rate Tests - submitted by W. S. Johnson, NASA Langley Research Center, Hampton, VA, March 1982.
NR001	Ti-6Al-4V Ti-8Al-1Mo-1V	$K_{Ic}$ $K_{Isc}$	Yoder, G. R., Cooley, L. A., and Crooker, T. W., "Effects of Microstructure and Frequency on Corrosion-Fatigue Crack Growth in Ti-8Al-1Mo-1V and Ti-6Al-4V," Naval Research Laboratory, Washington, D. C., Report 4678, December 1981.
PW002	Ti-6-2-4-2 Ti-6-2-4-6 Ti-8Al-1Mo-1V	da/dN da/dN $K_{Ic}$ ; da/dN	Beyer, J. R., Sims, D. L., and Wallace, R. M., "Titanium Damage Tolerant Design Data for Propulsion Systems," United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, FL, Report AFML-TR-77-101, Contract No. F33615-75-C-5130, June 1977.

TABLE 6.25 (CONTINUED)

REFERENCES FOR THE TITANIUM ALLOY DATA

PW003	Ti-6Al-4V	da/dN	Fatigue Crack Growth Rate Data on Titanium and Nickel Base Alloy from B. S. Schwartz, Pratt and Whitney Aircraft Group, Government Products Division, West Palm Beach, FL, July 1982.
RI005	CORONA 5 Ti-6Al-4V Ti-6Al2Sn4Zr6Mo	$K_{Ic}$ $K_{Ic}$ $K_{Ic}$	Chesnutt, J. C., et al., "Fatigue Crack Propagation and Fracture of Titanium Alloys," Rockwell International Science Center, Thousand Oaks, CA, and Department of Metallurgy and Material Science, Carnegie-Mellon University, Pittsburgh, PA.
RI006	Ti-6Al-4V	$K_{Isc}$	Ferguson, R. R., and Berryman, R. C., "Fracture Mechanics Evaluation of B-1 Materials," Rockwell International, B-1 Division, Los Angeles, CA, Contract No. F33657-70-C-0800, Report No. AFML-TR-76-137, October 1976.
SA001	Ti-6Al-4V	a-vs-N; da/dN	Rungta, R., Deel, O., and Frey, N., "Fatigue-Crack-Propagation Behavior of Materials of Several H-53 Helicopter Materials," Sikorsky Aircraft Company, Stratford, CT, Data Submitted by Battelle, Columbus, OH, 43201, Received October 20, 1992.
UD001	Ti-6-2-4-6	da/dN	Cervay, R. R., "Ti-6-2-4-6 Elevated Temperature Modeling of Fatigue Crack Growth Rate Data," University of Dayton Research Institute, Dayton, Ohio, Contract No. F33615-80-C-5011 Technical Memorandum UDR-TM-81-48, December 1981.
UD008	Ti-6Al-4V	$K_{Ic}$ ; da/dN	Cervay, R. R., "Beta Processed Titanium 6Al-4V Fracture Properties," University of Dayton Research Institute, Dayton, Ohio, Contract No. F33615-74-C-5024, Technical Memorandum UDRI-TM-75-08, July 1975.

## TABLE 6.25 (CONCLUDED)

### REFERENCES FOR THE TITANIUM ALLOY DATA

UM001

Ti-6Al-4V

$da/dN$

Wilson, D. A., "A Statistically Based Investigation of Microstructural Effect on the Fatigue Properties of Titanium and Titanium Alloys," Dissertation to University of Missouri, in Partial Fulfillment of PhD Requirement, December 1978.